

Designing Institutional Digital Repository for the University of Burdwan: A FLOSS Based Prototype

*Thesis submitted to the University of Burdwan in partial fulfillment of the
requirements for the Award of the Degree of Doctor of Philosophy (PhD) in Arts
(Library and Information Science)*

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Supervisors

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Burdwan, West Bengal
2013**

Dedicated to my father

Late Sachindranath Roy

Declaration

I hereby declare that the study entitled “**Designing Institutional Digital Repository for the University of Burdwan: A FLOSS Based Prototype**” submitted to the University of Burdwan, for the award of the degree of Doctor of Philosophy (PhD) in Arts (Library and Information Science) is the research work carried out by me under the joint supervision of *Prof. Subal Chandra Biswas*, Department of Library and Information Science, The University of Burdwan, Burdwan, and *Dr Parthasarathi Mukhopadhyay*, Department of Library and Information Science, The University of Burdwan, Burdwan (presently Associate Professor, Department of Library and Information Science, University of Kalyani).

I, further, declare that this work or any part thereof has not been submitted previously in part or full for the award of any degree, diploma, associationship, fellowship etc. of any university or institute.

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Supervisors' Certificate

*This is to certify that the thesis entitled, “**Designing Institutional Digital Repository for the University of Burdwan: A FLOSS Based Prototype**” is submitted by Bijan Kumar Roy for the award of the degree of Doctor of Philosophy (PhD) in Arts (Library and Information Science) of the University of Burdwan, Golapbag, Burdwan, West Bengal under our joint supervision. He has complied with all the requirements for the submission of the thesis.*

The work contained in the thesis is original and has not been submitted previously in part or full for the award of any degree or diploma of any university or institute.

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The brilliant ideas of developing subject archives in order to provide open access to scientific preprints by Paul Ginsparg led to the birth of new research field “*Institutional Digital Repository*”. I should extend my heart-felt thanks and regards to him.

While ostensibly representing one person’s work over several years, a PhD is the product of a huge team of people, and this is my opportunity to acknowledge those who helped me with this work. This PhD work came into reality due to enabling roles played by various individuals. Without their support it would have been extremely impossible to accomplish this task. I would therefore like to take this opportunity to pass my sincere thanks to those who in one way or another contributed to the successful completion of this work. This thesis stands on the shoulders of many giants. I am grateful for a fantastic team of supervisors. I would firstly like to thank and express my deep and sincere gratitude to the two persons who contributed at an idea-level, as precursors, six years ago, when I regarded myself more of a student than a researcher in LIS. They were the first persons with whom I have had discussions and conversations about the scholarly communications, open access movement, serials crisis, pre-prints, digital archive, digital library, open source software and electronic theses and dissertations (ETDs).

I gratefully acknowledge the support of both of these great scholars. They are none other than my PhD supervisors, Prof. Subal Chandra Biswas and Dr Parthasarathi Mukhopadhyay, Department of Library and Information Science, The University of Burdwan, West Bengal. I am grateful to my advisor, Prof. Subal Chandra Biswas for his guidance, support, and encouragement throughout the doctoral course. I would like to thank Dr Parthasarathi Mukhopadhyay for his enthusiastic involvement in this project and assisting me in many different ways with numerous suggestions. Really they deserve special mention. This work would not exist without them. I am thankful for the time I spent working with them. Their constructive comments at every step of the work made me to stay in the right direction to achieve the objective of the research study. Words of thanks are due to Prof. Amit Kumar Bandyopadhyay, Prof. Tridib Tripathi and Dr Chittaranjan Sain, faculty members in the Department of Library and Information Science at the University of Burdwan. Thanks to them for their feedback during the proposal stage of this thesis.

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Bijan Kumar Roy

Preface

“The larger the island of knowledge, the longer the shoreline of wonder”.

Ralph W. Sockman

My dream becomes true when I had an opportunity to interact with Prof. Subal Chandra Biswas and Dr Parthasarathi Mukhopadhyay at the University of Burdwan in 2007. Prof. Subal Chandra Biswas was the man who first encouraged me to pursue my research in this emerging area. And Dr Parthasarathi Mukhopadhyay, now Associate Professor of the University of Kalyani, was the main curator of this research work who helped me in designing and developing an integrated software framework based on international standards and best practices. At that time, Dr Mukhopadhyay was the only researcher in West Bengal, who had been organizing workshops, seminars etc. and had already published valuable papers related to this domain.

When I look back towards the trend of research in LIS field, it is evident that the research in the area of information seeking behaviour, survey, classification and cataloguing was given emphasis during 1960s and 1970s, Bibliometrics and Informetrics during 1980s, Cybermetrics and Webometrics from mid 1990s and community information service, library automation and networking, digital library, ETDs, digital repository 2000 onwards. This may be due to advent of Internet and Web. There has been a dramatic shift in scholarly communication process and traditional publishing models are transformed into electronic publishing models. Impact of globalization and change in the mode of scholarly communication from print to digital to Web-based had shifted the focus of research area in LIS. The tremendous dependency on the Web due to huge growth of Web-based resources created a curiosity among researchers and academicians in the area of information science as well as computer science to study and measure the nature and features of Web documents.

The importance of institutional digital repository has been realized and has increased tremendously during last decade as we are depending more and more on the Web-based resources. There are many initiatives, projects and recommendations at national and international levels that support free access to public funded research. I hope, the thesis may be useful to know the Indian IDRs at a glance, to know their actual positions in respect of global standards. The thesis has proposed a model IDR policy in the line of global recommendations and developed a software framework by which intellectual output of a university created by its members would be kept in one unique place for perpetual access. Therefore, the research work may be helpful to research scholars, academicians in all fields and may help administrators and policy makers in designing and developing Web-based Unicode-compliant multilingual IDR. It may help policy makers in developing model IDR system for their institutions.

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Introduction

Institutional Digital Repositories (IDRs) have become a hot topic and have been an emerging research field in Library and Information Science because of rising costs, flat budgets, and restricted access to information, as well as rapid changes in technology, scholarly practice, and patron expectations etc. There is increasing awareness that universities and research institutions lose valuable digital and print material due to difficulties in accessing them and lack of good preservation practices. As a remedy to the situation, the Open Access (OA) and Open Archives Movement (OAM) have been advocating the establishment of IDRs to provide free access to public funded research. Many influential groups, funding agencies at national and international levels have made statements and are beginning to recommend or to mandate self-archiving of work paid for by their research funds. But there is no such mechanism for holding intellectual output of the institutions in one unique place in order to provide global access to local research outputs. The significance of the IDRs for social and economic life is well-accepted phenomenon and also its influence on higher education is no exception.

The main objective of the study is to develop a standard IDR model and formulate a policy on the basis of international standards and to design and develop FLOSS (Free/Libre Open Source Software) based Web-enabled IDR system on the basis of national and global recommendations. The study suggests best practices and recommendations for future developers and will become a guiding tool for policy makers and administrators.

Effective implementation of IDRs has proved problematic. This thesis has been structured around two core sections: *a theoretical framework based on existing literature*, and an *empirical study* e.g. implementation of theoretical model into a software framework using open standards and open source software. The overall research questions are: (a) What is the status of the Indian IDRs? (b) How to design a theoretical model for University-specific IDR? (c) How to convert the theoretical model into a software framework? (d) How to apply open source software and open standards in designing the IDR software framework? What are the procedures for making the IDR software framework a Unicode-compliant entity? (e) How to design and apply multilingual user interfaces at different levels and different points of utilization?

Scope

This work takes into account the relevant English-spoken literature produced in last decade mainly in journals available in DOAJ (Directory of Open Access Journals) directory, conferences, seminars etc. This work doesn't take into account specific applications, software or project, since their analysis and comparing would have been too ambitious for the economy of this work. Significant projects were considered where they provided relevant contribution to development and establishing broader and applicable

models. The study covers all the self archiving policies registered in ROARMAP (Registry of Open Access Repository Material Archiving Policies) database. The study also consulted all IDRs registered in OpenDOAR (Directory of Open Access Repositories) and ROAR (Registry of Open Access Repositories) databases. More specifically, the study put emphasis mainly on IDRs. It does not cover others databases.

Methods

The Burdwan University Research Archive (BURA) software framework has been developed following several open standards and open source software (OSS). A policy model for the software framework has been formulated in the line of global recommendations and best practice guidelines. A series of software and related standards have been selected against pre-defined parameters for different clusters of the framework in order to convert this theoretical model into the proposed software framework. The software framework incorporates all the necessary customizations to make it Unicode-compliant Bengali script based user interface for browsing and searching Indic script based documents. This research work has incorporated an ontology driven Web-enabled knowledge organization system (KOS) (DDC 22nd edition – up to 3rd summary) in BURA software framework in Bengali script. The BURA software framework incorporates a federated searching mechanism for harvesting metadata from Open Archives Initiative-Protocol for Metadata Harvesting (OAI-PMH) compliant repositories with additional utilities like interactive communication tools for its seamless integration with IDR cluster of the framework. Finally, a ready to use off-the-shelf product has been developed so that other universities/institutes can apply this product without reconfiguring the system.

Results

Furthermore, the dissertation includes a chapter that presents and discusses the research findings in a theoretical framework and translated the theoretical framework into a software service framework. Initially the chapter presents and discusses terminology needed for analyzing OA and scholarly communication. The results show that only a few elite institutes have established IDRs in India. But most of the IDRs are not based on research data and are not up to the global standard. The problems are mainly three fold: *technical* (hardware and software), *non-technical* (administrative, policy issue) and *cultural* (social acceptance, advocacy etc). In practice the ranges of resources are limited and are mainly text based. There is no provision for multilingual information processing, searching and retrieval. There is no initiative to setting up Registry of Indian IDRs and no such mandate on OA publishing at national level. Blogs, RSS, academic pages and discussion forums are important web services that link to items within repositories. Apart from these features, this IDR framework explored the path to handle Unicode-compliant Indic-script based interfaces and subject access systems. This framework also provides some additional services to scholars like alerting services, federated searching and interactive interpersonal communication through blog and discussion forum.

Keywords: *Digital library, digital repositories, digital archive, institutional digital repositories, open access, OAI-PMH, Open source software, self archiving.*

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List of Abbreviations

ACM	Association for Computing Machinery
ACRL	Association of College and Research Libraries
AGORA	Access to Global Online Research in Agriculture
ALA	American Library Association
ALPS	Association of Learned and Professional Society
ALPSP	Association of Learned and Professional Society Publishers
API	Application Programming Interface
APSR	Australian Partnership for Sustainable Resources
ARC	Australian Research Council
ARL	Association of Research Libraries
ARNO	Academic Research in the Netherlands Online
ARIIC	Australian Research Information Infrastructure Committee
ARROW	Australian Research Repositories Online to the World
ASCII	American Standard Code for Information Interchange
BASE	Bielefeld Academic Search Engine
BIS	Bureau of Indian Standard
BOAI	Budapest Open Access Initiative
BSD	Berkeley Software Distribution
BURA	Burdwan University Research Archive
CARL	Canadian Association of Research Libraries
CC	Creative Commons
CCSDS	Consultative Committee for Space Data Systems
C-DAC	Centre for Development of Advanced Computing
CERN	European Organization for Nuclear Research
CGIAR	Consultative Group on International Agricultural Research
CGI	Common Gateway Interface
CNI	Coalition for Networked Information
CNRI	Corporation for National Research Initiatives
CODATA	Committee on Data for Science and Technology
CSIR	Council of Scientific & Industrial Research
CV	Curriculum Vitae
DAEDALUS	Data Providers for Academic E-content and the Disclosure of Assets for Learning, Understanding and Scholarship
DARE	Dutch Academic Repository
DARE	Digital Academic Repositories
DART	Dataset Acquisition, Accessibility, and Annotation e-Research Technologies
DCC	Digital Curation Centre
DCMES	Dublin Core Metadata Element Set
DINI	Deutsche Initiative für Netzwerk Information
DL	Digital Library
DLIST	Digital Library of Information Science and Technology

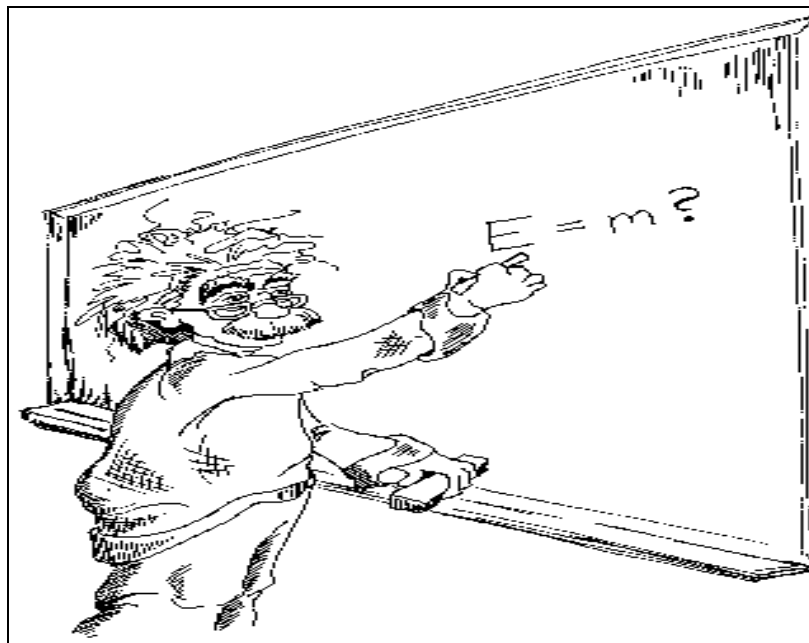
DPC	Digital Preservation Coalition
DOAJ	Directory of Open Access Journals
DOI	Digital Object Identifier
DRIVER	Digital Repository Infrastructure Vision for European Research
DRS	Digital Repository Service
EAD	Encoded Archival Description
EC	European Commission
E-LIS	E-prints in Library and Information Science
EPSRC	Engineering & Physical Sciences Research Council
ERCIM	European Research Consortium for Informatics and Mathematics
ETD	Electronic Theses and Dissertations
ETD-MS	Electronic Theses and Dissertations – Metadata Standard
EU	European Union
EUA	European University Association
FAIR	Focus on Access to Information Resources
FEDORA	Flexible Extensible Digital Object and Repository Architecture
FLOSS	Free Libre Open Source Software
FRPAA	Federal Research Public Access Act
FAO	Food and Agricultural Organization
GIST	Graphics and Intelligence based Script Technology
GOASP	Group for Open Access to Science Publications
GUI	Graphical User Interface
HINARI	Health Inter-Network Access to Research Initiative
HTML	HyperText Markup Language
HTTP	Hypertext Transfer protocol
HP	Hewlett Packard
IAA	Information Access Alliance
ICAAP	International Consortium for the Advancement of Academic Publication
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICTs	Information and Communication Technologies
IDOA	Immediate-Deposit & Optional-Access
IDR	Institutional Digital Repository
IFLA	International Federation of Library Associations
INASP	International Network for the Availability of Scientific Publications
INDEST	Indian National Digital Library in Engineering, Sciences and Technology
INFLIBNET	Information and Library Network
IMS-LOM	Learning Object Metadata
IOSN	International Open Source Network
IPR	Intellectual Property Right
IR	Institutional Repository
ISCI	Indian Standard Code for Information Interchange
ISFOC	Indian Standard Font Code
ISO	International Organization for Standardization
IT	Information Technology
IWI	Innovation in Scientific Information Supply
JISC	Joint Information Systems Committee

JSE	Java Servlet Engine
LAN	Local Area Network
LOCKSS	Lots of Copies Keeps Stuff Safe
MARC	Machine Readable Cataloguing
METS	Metadata Encoding and Transmission Standard
MHRD	Ministry of Human Resource Development
MIRACLE	Making Institutional Repositories A Collaborative Learning Environment
MIT	Massachusetts Institute of Technology
MODS	Metadata Object Description Schema
MTA	Mail Transfer Agent
NDLTD	Networked Digital Library of Theses and Dissertations
NKC	National Knowledge Commission
NIH	National Institutes of Health
NISO	National Information Standards Organization
NLM	National Library of Medicine
NOS	Network Operating Systems
OA	Open Access
OAA	Open Access Archives
OAI	Open Archives Initiative
OAI-PMH	Open Archives Initiative-Protocol for Metadata Harvesting
OAIS	Open Archival Information System
OAJs	Open Access Journals
OAK	Open Access to Knowledge
OAR	Open Access Repository
ODLIS	Online Dictionary for Library and Information Science
OECD	Organization for Economic Co-operation and Development
OpenDOAR	Open Directory of Open Access Repositories
OS	Operating system
OSI	Open Society Institute
OSS	Open Source Software
PALS	Publisher and Library/Learning Solutions
PADI	Preserving Access to Digital Information
PNAS	Proceedings of the National Academy of Sciences
PDF	Portable Document Format
PKP	Public Knowledge Project
PLoS	Public Library of Science
PREMIS	Preservation Metadata Implementation Strategies
QUT	Queensland University of Technology
RcLIS	Research in computing and Library & Information Science
RDBMS	Relational Database Management System
RDF	Resource Description Framework
RePEc	Research Papers in Economics
ROAR	Registry of Open Access Repositories
ROARMAP	Registry of Open Access Repository Material Archiving Policies
RoMEO	Rights METadata for Open Archiving
RSS	Really Simple Syndication, Rich Site Summary

SC	Scholarly Communication
SCORM	Sharable Content Object Reference Model
SSL	Secure Sockets Layer
SOA	Service Oriented Architecture
SHERPA	Securing a Hybrid Environment for Research, Preservation and Access
SKOS	Simple Knowledge Organization System
SMTP	Simple Mail Transfer Protocol
SPARC	Scholarly Publishing and Academic Resources Coalition
SWORD	Simple Web-service Offering Repository Deposit
SWOT	Strengths, Weaknesses, Opportunities and Threats
TARDis	Targeting Academic Research for Dissemination and Disclosure
TDIL	Technology Development for Indian Languages
UKOLN	United Kingdom Office for Library and Information Networking
UCS	Universal Character Set
UGC	University Grants Commission
UNL	Universal Networking Language
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
UTF	Unicode transformation format
VIF	Version Identification Framework
VLEs	Virtual Learning Environments
W3C	World Wide Web Consortium
WSIS	World Summit on the Information Society
WWW	World Wide Web
XML	Extensible Markup Language

Chapter 1

Introduction



“And I can’t tell you the rest until the journal comes out.”

(Bachrach et al., 1998)

Structure

- 1.0 Introduction
- 1.1 Background of the Study
- 1.2 Objectives of the Study
- 1.3 Statement of the Research Problems
- 1.4 Hypotheses
- 1.5 Methodology
- 1.6 Significance of the Study
- 1.7 Definitional Analysis
- 1.8 Conspectus

1.0 Introduction

Global trends in scholarly communication increasingly gravitate towards a digital environment, and the development of the open access movement (OAM) and electronic publishing have been outgrowths of this process. Scholarly communication, and more specifically scholarly publication, is an important manifestation of knowledge generation and knowledge diffusion that captures and preserves knowledge assets more effectively and transparently than in the past and provides immediate online access of local research outputs globally. The commonly held reasoning behind open access scholarly communication is that greater access to the public-funded research literature, in effect greater knowledge diffusion, will lead to the advancement of science and technology, and will be especially advantageous for developing countries like India.

Scholarly publication process has its roots in the need for communication between academicians, researchers, and scientists. Electronic publishing and electronic access have brought tremendous changes in scholarly communication. Prior to the invention of the printing press, scientists communicated via the exchange of letters and via public debates akin to latter-day conferences. But electronic publishing and new types of digital resources have brought howling changes in traditional scholarly communication system and are changing our notions of what scholarly publishing means by modifying the way researchers produce, communicate and access information. Scholarly communication has changed dramatically after the introduction of the Internet in public domain during early 1990s. It is undeniable that the Internet and World Wide Web (WWW), as distributed information system, have brought many changes, for life beyond scholarly communication, as well as for the process of scholarly communication. With the development of electronic communication, academic research has introduced new technologies and tools for scholarly communication. It facilitates geographically dispersed information access and retrieval through online mechanisms. It has enabled information to be accessed and disseminated far more easily than ever before. Our ways of work and communicating have been and are changing. Said evolution of the scholarly communication system has garnered much attention in the past decade, it's having been driven by three factors, namely -

1. the 'serials crisis' or serial pricing crisis (Cummings et al., 1992; King & Tenopir, 1999; Houghton, Steele & Henty, 2004);
2. the growth in scholarly research output (Crane, 1972; Pouris, 2003); and
3. the advent and ubiquity of the Internet, in the context of the Information Society.

Scholarly communication has been affected by the so-called '*serials crisis*' in the last 30 years and scholarly journal prices have increased more rapidly than research institutions' budgets (Greco et al., 2006). Another expert (Carlson, 2002) reported

that ARL (Association of Research Libraries) statistics estimate that journal subscription rates have gone up an average of 8.5 percent per year since 1986, while library budgets have increased 5.6 percent per year. This situation is well described by Peter Suber, who talks about '*permission crisis*' (Suber, 2003), relating to financial and technical barriers to access (such as subscription fees and login/password requirements) risen by commercial publishers. Economic and technological changes are cited as the major reasons contributing to the notable evolution of the current scholarly communication system (Thorin, 2003; Moller, 2006; Swan, 2007). Pickton (2005) identified several other technological, financial, ethical issues responsible for open access (OA) publishing. In 1998 the ARL founded SPARC (Scholarly Publishing and Academic Resources Coalition) to address the serial crisis and correct the imbalances in the scholarly publishing system (Joseph, 2006).

It is also important to recognize the link between institutional repositories (IRs) and the open access movement (OAM) and how these influencing potential repository contributors. To describe and explain the context in which IRs sit, it is necessary to:

- explain the OAM including the reasons for its emergence; and
- describe the methods by which OA can be approached.

A. Open Access Movement (OAM)

"Knowledge wants to be free" (Arunachalam, 2008).

The open source software, open access and open standards movements are gaining tremendous momentum. OAM also known as '*Open-Access Publishing*' or Free Online Scholarship is a social movement that includes open source software and the types of social structures that produce it; open standards; open contents including courseware, digital repositories, and the creative commons; academic alliances for creating academic middleware; open intellectual property policies more generally; keeping the Internet architecture open; and a growing sense among academic leaders that the university should serve as a counterbalance to the overly restrictive objectives of the digital rights movement. In the last few years, the movement has gained a lot of strength among the academic and scientific institutions.

Prior to the advent of the Internet, publishers and academic societies dominated scholarly communication, and researchers channeled their research output solely through authoritative publishers and academic societies. The first scientific journal known as '*Philosophical Transactions*' launched by 'Royal Society of London' began in 1665 to enable researchers to share their work quickly and widely and to

establish the priority of researchers investigating the same problem (Thorin, 2003; Swan, 2007).

In these circumstances, very recently an academic movement called the ‘OAM’ was organized as an alternative to the conventional scholarly communication through journals and books to promote free access to research products and to encourage university libraries to be responsive to their members' requests (Yeates, 2003). The OAM arose at the beginning of 1990 as a reaction against the traditional scientific publishing model. The advent of the Internet and digital technologies made it possible for research to be shared in entirely new ways. Gradually, traditional publishing models are shifting as electronic publishing models. Traditional publishing models are shifting as electronic publishing changes the ways that libraries purchase and access scholarly materials (Association of Research Libraries, 2006).

Global trends in scholarly communication increasingly gravitate towards a digital environment, and the development of the OAM and electronic publishing have been outgrowths of this process. Two contemporary developments in particular have helped shape the nature of today’s institutional repositories (IRs): the emerging knowledge management movement; and the maturing, but still rapidly advancing, technology of content or asset management in the digital information system. The knowledge management movement of the 1990s influenced the development of IRs. The major driving force behind the development of IRs has been the dramatic shift in scholarly communication especially within the past five to ten years. Repositories and their relationship with the OAM constitute a new trend in scholarly communication worldwide. This is typically reflected in the success story of open access digital repositories worldwide.

B. Open Access Roads

New models of scholarly communication are evolving and different models are being developed to provide access, manage costs, and manage an organization’s scholarly output, especially at colleges and universities. The currently evolving model is referred to as ‘*Open Access*’. OA is elaborated upon as one current model of these aforesaid changes in scholarly communication. There seem to be no other competing new models at present which either oppose or complement OA, there seems to be at present the traditional (publication) model and OA. The two schools of thought within OA are the journal reform school, and the self-archiving school. These two parallel but complementary paths (Fig. 1.1) for achieving OA are sometimes referred to as the “*Gold*” (publish in an open access journal (OAJ) and “*Green Roads*” to open access (publish in a non-OAJ but archive in an open access archive (OAA) (Antelman, 2004; Chan & Costa, 2005; Bailey, 2006b; Harnad, 2005).

Developing repositories in order to provide access to the world's research output is one solution and has emerged as a new publishing tool. In these contexts - restricted access to knowledge, changing scholarly practices, and support for open access, rapidly evolving information technology - IRs have emerged as a potential solution. Thus, this new Web-based distributed system seems to have spawned two contradicting developments in scholarly publishing: one towards enabling and promoting OA and the other towards restricting it and preserving the barriers to scholarly works.

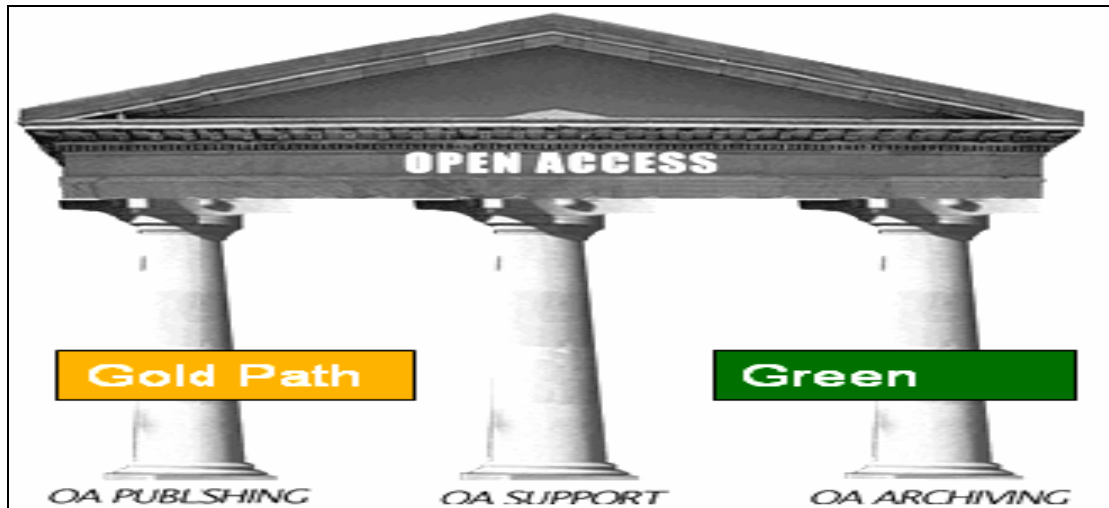


Fig. 1.1: Open Access Roads
(Source: Singh, 2008)

The rapid growth of digital assets creates challenges for the academic institutions like universities, research organizations in the use, management, archiving and application of digital information and datasets. It is found that about 80-85% of digital intellectual output of universities is never made accessible to the public (The Open Citation Project, 2004). Academic institutions have been grappling with how to manage the digital intellectual output they produce including journal articles, conference papers, reports, theses and dissertations, teaching materials, artwork, research notes, and research data. Universities are finding new ways to capture, manage and disseminate these scholarly electronic resources, and institutional repositories have been proposed as a tool to aid academics to manage and distribute their digital materials. Many universities and research institutions throughout the world are investigating, piloting, and developing systems for building collections of digital resources and learning materials in the shape of open access repositories (Rothery & Bell, 2006) that will enable faculty and researchers to upload and download scholarly literature and use them to share resources with each other either within the institution or across the region, or more widely still.

Clearly, technology has made it easy to create, store and access digital materials. Several broad technological developments in the digital information system were also pushing individuals and their organizations towards the creation of institutional repositories (Lynch, 2003). In this venture open source software (OSS) is one step ahead. The OSS movement has its root in the 1970s and continuing to grow its popularity to date. The movement gained momentum with the release of two open source systems: Eprints, developed by Stephen Harnad and the team at the University of Southampton in late 2000 (Tansley & Harnad, 2000), and MIT's DSpace in 2002 with support from Hewlett Packard (Barton & Walker, 2003). The development of OSS to manage electronic documents created open source alternatives for IDR development.

This Web-enabled distributed IDR system is a socio-technical concept. It is a multi-faceted domain. It is not all about information storage and retrieval. The basic logic behind this research is organizing and management of resources and bibliographic items to support open access to knowledge. In this sense IDR is also a psycho-social concept. Another facet of this research is developing Unicode-compliant IDR system based on FLOSS (Free/Libre Open Source Software) software framework. IDRs all over the world now see opportunities to create databases that can be accessed via Web in order to provide global access to local research produced by academicians, researcher, scientists working in universities and research organizations. Technology tools in launching digital repositories are not so easy and can't be mastered given a little time and exposure. No single software solution is presently available to meet the requirements of such complex information systems. However, adding contents to digital repositories is protracted, and scientific and academic communities are not fully aware of potential of open access to information. Library and informational professionals have a daunting task of convincing authors of the importance of OAM. This is the new role of library professionals. Their role should not be confined to traditional information acquisition, organization, dissemination and preservation. They have an active role to play in the publishing process.

Under such circumstances, this study is an attempt to build up a conceptual model that deals with:

- Mechanism of integrated processing of IDR resources of different types along with provision for support services that are interactive, collaborative and participative;
- Designing a set of policies for different IDR components on the basis of global recommendations and 'best practice' guidelines.
- Design of Web-enabled software framework for the University of Burdwan on the basis of policies and standards as framed by using open standards and utilizing Free/Libre Open Source Software (FLOSS); and
- Development of Unicode-compliant Bengali script based interface along with mechanisms for multilingual searching, browsing and subject based hierarchical browsing by employing standard classification scheme.

The FLOSS based software framework is designed keeping in view the requirements of the University of Burdwan. This Web-enabled software solution centers on the following attributes:

- Use of internationally agreed upon data standards/formats for managing IR resources supported by data standardization tools including domain-specific vocabulary control device;
- Integrated processing of IDR resources and bibliographic items to ensure integrated search and browse facility from user interface;
- Development of Unicode-compliant mechanism for Bengali script based user interface, processing of Bengali script based IR resource, multilingual searching, and subject access support system;
- Supporting interactive communication processes through Blog, Wiki and Discussion forum; and
- Developing federated search option for multiple IDRs from a single-window search interface.

1.1 Background of the Study

The Open Access Repositories (OARs) movement in general is neglected in India. Only eighty (80) repositories have been developed in the country as per OpenDOAR (Directory of Open Access Repositories), and ROAR (Registry of Open Access Repositories) databases. The concept is not new but it became popular relatively late compared to other developed countries.

Current adoption levels of OARs are pleasingly high. The two major registries of OARs (viz. OpenDOAR & ROAR) show that adoption in developed countries is already very high, with some developing countries also starting to take the advantages that open access confers. The area is in rapid development, and ROAR statistics show a steep incline from around 2001 to the present in the availability of both open archives and open records in those archives available via OAI (Open Archives Initiative).

As per OpenDOAR (<http://www.opendoar.org/find.php>) database, there are more than 2381 (up to June, 2013) repositories through out the world (Fig. 1.2). Another database, ROAR (<http://roar.eprints.org/view/geoname/>) reported that more than 2904 OARs exist. But there is a vast difference between OpenDOAR and ROAR databases in terms of number of repositories registered. This is because many of them do not have their own domain or sub-domain, and for this reason it is not possible to add them in this study. As per the OpenDOAR and ROAR databases, every day one repository is being added to the databases. The following table (1) shows the growth and development of OARs throughout the world.

Year	No. of Repository added (year-wise)	
	ROAR	OpenDOAR
2013	145	150
2012	664	180
2011	333	300
2010	491	270
2009	344	240
2008	296	273
2007	215	568
2006	359	251

Table 1.1: Growth of OARs through out the World
(Source: OpenDOAR, 2012; ROAR, 2012)

So research in this area and developing a model IDR for the University of Burdwan through OSS is prime objective of this work. But technically it is not so easy in view of the present scenario. There are several problems (vide section 3.12 of chapter 3) of Indian OARs other than technical and non-technical problems.

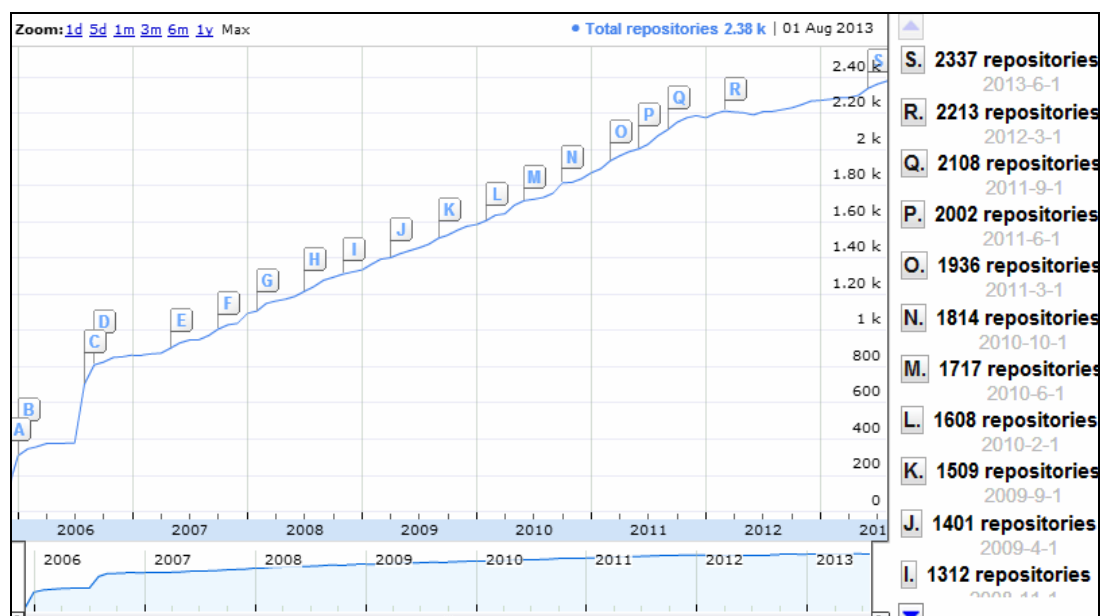


Fig. 1.2: Growth of the OpenDOAR Database – Worldwide
(Source: OpenDOAR, 2012)

But situation is fast changing and a close look reveals a shining picture. Our country has been the most prominent partner in the field of open knowledge movement. Our professionals and working librarians are trying to build up necessary information infrastructure, essential for open access development and our experts are trying to

establish digital library and institutional repository with free open source software (FOSS). India in its own way made its contribution by developing and launching more than 80 repositories (ROAR, 2012). Several agencies, learned societies, professional bodies have come forward and have established IDR for their own. A nation-wide movement has started and government organizations like the UGC (University Grants Commission), NKC (National Knowledge Commission) recommended OA to public funded research. In one word, OA to information is the realization of Ranganathan's Five Laws of Library Science in the internet world.

In April 2004, there were only four (4) institutional repositories in India (OpenDOAR, 2012; ROAR, 2012) and this number had climbed to more than eighty (80) in 2013 (June) with an average increase of about nine (9) new repositories per year. Based on worldwide numbers in both OpenDOAR and ROAR databases, this growth has placed India as the seventh leading nation in IDRs development. Much of this success is undoubtedly connected to government support as well as sponsorship from MHRD (Ministry of Human and Resource Development), UGC, NKC and other professional (e.g. Information and Library Network (INFLIBNET) and research institutes. As a result, a silent revolution is going rapidly in India in the area of repository development. Under such circumstances, it is felt that a research study in this area can be conducted to develop an IDR model based on OSS having Web-enabled and Unicode-compliant software framework that will manage IDR resources available in the organization in different forms and formats. It is expected that this software framework may act as an off-the-shelf solution in managing resources of the universities.

1.2 Objectives of the Study

In view of the background of this research, the objectives may be framed into two groups as follows:

1.2.1 General Objectives

The main objective of the study is to develop a standard IDR model and formulate a policy for the University of Burdwan that will support information needs of the university stakeholders. The general objectives of this study, as a whole, is to develop a Web-enabled distributed open access IDR model for the University of Burdwan, which can manage and organize its resources including Bengali language based interface and provision of multilingual data processing with additional utilities like federated search, interactive communication tools and standard subject access system.

1.2.2 Specific Objectives

The general objective of this study is multi-faceted one. It includes a number of interlinked and interrelated specific objectives. The specific objectives are enumerated below:

- A. To design and develop a FLOSS (Free/Libre Open Source Software) based prototype IDR system based on framed architecture by applying or using Open Standards, Universal Character Set and other related Open Source Software on the basis of global and national recommendations;
- B. To make IDR system accommodative and flexible in terms of specific requirements of the University of Burdwan and to make system compliant with global standards and policies related to domain;
- C. To develop mechanisms for archiving, processing and retrieval (including sophisticated search mechanisms) of a wide variety of information bearing objects available in different forms and formats on the basis of internationally agreed upon data format, data standardization tools and their incorporation into the software framework;
- D. To apply open standards in the design and development of the IDR system as far as information organization, retrieval and harvesting are concerned including development of federated searching and interactive communication support as additional utilities for the system; and
- E. To develop Unicode-compliant Bengali script based User Interface to support integrated searching and browsing of regional languages based resources and incorporating standard subject category system in Bengali script.

1.3 Statement of the Research Problems

The objectives of this project, as framed in previous section, directed this research study towards a set of definite research problems. The research problems of this study are represented by a descriptive statement as below:

“DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE”.

A close examination of this descriptive statement reveals that it is amenable to be converted into a set of five interlinked questions and these are as follows.

- A. How to design a theoretical model for University-specific IDR? What should be the standard components and parameters for it? How to link the parameters with the requirements of users and administrators of IDR? How can global recommendations and best practice guidelines in the domain be framed to create a model theoretical prototype?
- B. How to convert the theoretical model into a software framework? How to apply open source software and open standards in designing the IDR software framework? What should be the selection criteria for IDR software and related standards for different clusters of the software framework?
- C. What are the procedures for making the IDR software framework Unicode-compliant entity? How to develop mechanisms for processing, retrieval and display of Indic script based information objects? What are the ways to develop and incorporate Indic script based subject access system?
- D. How to incorporate into the IDR software framework (for the University of Burdwan) utilities like federated searching and interactive communication tools for scholar?
- E. How to implement and integrate the prototype IDR in the existing information access system of the University of Burdwan? How to design and apply multilingual user interfaces at different levels and different points of utilization? How to make the prototype IDR interoperable and open for harvesting? And how to make distribution copy of the software framework in the form of ready off-the-shelf product for the benefit of research and academic bodies?

1.4 Hypotheses

This research study seeks to understand what university members believe about IDRs including their perceived benefits, ease of use, and role within greater system of scholarly publication. It aims to support successful implementation and maintenance of the university's IDR. However, in response to the research problems, as formulated in the foregoing section, this research study centres on the following hypotheses:

- A. It is possible to design a theoretical model with carefully crafted techno-organizational components on the basis of global recommendations, best

practice guidelines, and taking into account specific requirements for the University of Burdwan;

- B. The theoretical model is amenable to be converted into an accommodative software framework through the application of related open standards and open source IDR software for different clusters of the framework;
- C. It is quite feasible to make the software framework Unicode-compliant through the application of an array of FLOSS based multilingual tools for storing, processing and retrieving of digital knowledge objects available in Indic scripts in general and Bengali script in particular;
- D. SKOS (Simple Knowledge Organization System), a W3C standard can be utilized for converting any standard classification into Web-enabled access format for its seamless integration with IDR framework;
- E. The Unicode-compliant and FLOSS based software framework can act as IDR system for the University of Burdwan in Web-enabled environment and can be integrated seamlessly with the additional utilities like federated searching and interactive communication tools; and
- F. The entire model framework with all of its complexities can be converted into ISO image for utilization by other institutes as an off-the-shelf product.

1.5 Methodology

As stated earlier, the general objectives of this study is to develop a multilingual Web-enabled distributed IDR model for the University of Burdwan and specific objectives are directed towards the accomplishments of the general objectives through development of technical components of the model. The methodology to be followed for the proposed research work may be divided into three conceptual areas.

- A. Part I - Development of the theoretical model;
- B. Part II – Selection of standards and software; and
- C. Part III - Implementation on the basis of Part I and Part II of the work.

The proposed study has been divided into three main parts.

Part-I is concerned with development of the theoretical model. Part-II deals with the designing of prototype IDR for the University of Burdwan and Part-III is implementation of the proposed model. The steps under the above mentioned three parts are given below:

Part I - Towards the Model

It includes following steps and sub-steps:

Step 1: Understanding IDR, its application and implementation;

Step 2: Study of existing IDR initiatives;

2.1 Global initiatives;

2.2 Indian initiatives; and

2.3 Identification of key features of national and international IDRs and policy making agencies.

Step 3: Identification of requirements for IDR of the University of Burdwan;

3.1 Study of the University Grants Commission guidelines;

3.2 Study of the requirements of the University of Burdwan;

Step 4: Identification of Parameters for developing IDR;

4.1 Content related parameters;

4.2 Standards related parameters;

4.3 Archiving parameters;

4.4 Collection development parameters;

4.5 Collection management parameters;

4.6 Collection organization parameters including subject access system;

4.7 Multilingual parameters;

4.8 Technical parameters;

4.9 Retrieval parameters;

4.10 User interface parameters;

4.11 Workflow parameters;

4.12 Legal parameters; and

4.13 System management and Administration parameters.

Step 5: Development of the model IDR for the University of Burdwan (to be named as Burdwan University Research Archive - BURA) on the basis of identified parameters;

Part II - Towards the Prototype

Step 6: Development of criteria for different facets of BURA;

Step 7: Identification of open standard metadata schemas for each document types;

Step 8: Selection of metadata standard for each document type against the selected criteria;

Step 9: Determination of technical specifications of BURA;

Step 10: Identification of FLOSS based IDR software as per the technical specifications of BURA;

Step 11: Development of software selection criteria for BURA;

Step 12: Selection of IDR software on the basis of selected criteria;

Step 13: Installation of the selected IDR software along with necessary FLOSS based companion and /or dependent software;

Step 14: Incorporation of selected metadata schemas into the prototype BURA; and

Step 15: Development of Unicode-compliant environment for processing Indic script based documents;

Step 16: Development of Indic script based subject access system;

Step 17: Inclusion of federated search mechanism; and

Step 18: Design and inclusion of communication support system for scholars.

Part III - Towards Implementation

The final elements of the methodology involve the following steps:

Step 19: Implementation of crosswalks and interoperability standards and development of OAI-PMH (Open Archives Initiative-Protocol for Metadata Harvesting) compliant IDR;

Step 20: Designing of user interface in two levels;

20.1 End-User access interface with support for subject based browsing; and

20.2 Submission interface (including support for subject authority sub-system).

Step 21: Incorporation of vocabulary control devices (existing open standards tools) in two levels;

21.1 End-User searching with support for Indic script based subject-driven browsing; and

21.2 Indexers/Submitters.

Step 22: Uploading of records through distributed processing i.e. remote submission process;

Step 23: Design of single window embedded search interface for multiple IDRs;

Step 24: Development of auto alerting services and platform for scholarly interaction through blogs and discussion forum;

Step 25: Beta testing of BURA and final release through Web-hosting; and

Step 26: Generating ISO image from BURA software framework for its ready implementation in other institutes.

1.6 Significance of the Study

It is important for any research study to justify the need of the research under study i.e. to clarify the following question:

Why the research problem was considered significant for investigation? Or why this area was chosen for research?

Section 1.1 of this chapter explains the situation behind the formulation of research problems of this study. The statement of research problem (section 1.2) and interlinked questions associated with it is also helpful in establishing the significance of this study. The following are the main reasons behind conducting the investigation of this study.

1. It (IDR) is a multi faceted domain and requires application of different domain specific software for developing a fully functional digital solution. On the other hand, open source software and open standards in different application domains are emerging rapidly as viable alternatives that allow library professionals to work at system level. But no research till date has suggested application of open source software (OSS) for designing university-specific IDR system.
2. Academic institutes like universities, research centres are generating valuable knowledge resources in the form of theses, dissertations, project reports, courseware, pre-prints etc., but till today no model exists in India that deals with organization of intellectual resources created by its members and dissemination of such resources over the web to overcome money, space, and time limitations.
3. Existing IDR systems (mainly research institutes and R & D sector) are not based on global standards and lack standardization in organization of resources. This study, to overcome this limitation, recommends application of internationally agreed upon data formats and deals exclusively with the integration of data standardization tools like vocabulary control devices, code list etc for organizing IDR resources.
4. Multilingual digital libraries are essential in India in order to provide wider access of IDR resources to a wider section of community. In support of this view, local language based interfaces for searching, browsing, registration and multilingual data processing environment is essential for any IDR system. Unicode, as an open standard, provides a solution in this direction. This research deals with the development of Unicode compliant Bengali language based IDR system that provides not only interface in Bengali language but also Bengali script based searching, browsing of IDR resources and services.
5. Existing IDR systems in national and international level lack policy document and do not suggest any guidelines and best practices based on global recommendations. This study, in order to solve this problem recommends a

university-specific model policy based on international standards and best practices that will help other institutes in planning and implementing the IDR system.

6. Most of the studies are theoretical in nature and do not provide any technical solution and direction towards the building up university-specific IDR system (keeping in view the specific requirements) using open source software (OSS) and based on best practice guidelines, global recommendations etc. But this research work proposes a theatrical framework and provides valuable practical direction towards this technical and other non-technical matters by developing a software framework on the basis of framed architecture using open standards and OSS.

1.7 Definitonal Analysis

Before going to the study, it is better to provide a brief overview of key concepts used in this study.

A. Open Access

There is no agreed definition of open access. It (OA) is not a straight-forward concept. It is not a technology; rather it is a philosophy which is based on the freedom of information exchange and access; and it is also an action and a development and it is more a reality. It does not mean “anything goes”. It has many different definitions and approaches, numerous supporters and abundant detractors. It raises a variety of questions. Open Access has variously been referred to as ‘*open access*’ (Budapest Open Access Initiative, 2002), ‘*self-archiving*’ (Harnad, 1999), and ‘free online scholarship’ (Suber, 2002a). Generally it refers to the free availability of peer-reviewed literature on the public internet, permitting any user to read, download, copy, distribute, print, search, or link to the full texts of the articles. It means freely available online to anyone anywhere, with no charges imposed for access. Open access is defined as the mode of scholarly communication aiming at wide distribution of scholarly content with neither price nor any other copyright restriction (Chan & Costa, 2005; Yiotis, 2005). Suber (2002b) was of the view that open access to scientific articles means online access without charge to readers or libraries. The concept has existed since the mid-1990s, with champions such as Stevan Harnad (Harnad, 1994) expressing his ‘*subversive proposal*’. More recently, OA has found much wider support through out the world mainly after the publication of few important public statements and declarations commonly known as the three Bs, the Budapest, Berlin, and Bethesda. The following two definitions provide a

comprehensive explanation of open access. The Berlin Declaration of Open Access (2003) defines open access as a new mode of scholarly communication through which “the author(s) and right holder(s) of such contribution grant(s) to all users a free, irrevocable, worldwide right of access to, and a license to copy, use, distribute, transmit, and display the work publicly and to make and distribute derivative works, in any digital medium for any responsible purpose, subject to proper attribution of authorship”. The Budapest Open Access Initiative (2002), launched in February 2002 and spearheaded by the Soros Foundation’s Open Society Institute states that by Open Access they mean:

“free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself”.

The declaration acknowledges that the literature referred to in their definition is not free to produce, but they add that “... experiments show that the overall costs of providing open access to this literature are far lower than the costs of traditional forms of dissemination.” The Bethesda Statement (2003) had the goal of providing open access to primary scientific literature as quickly as possible.

B. Open Standards

A standard is an agreement between a number of (but not necessarily all) players within a certain area of technology. Recently one question has been attracting great attention: whether a specific standard is of open or a proprietary in nature. “*Open standards*” has become a very popular term in recent policy debates, but controversy abounds over what it actually means. Open Standard (OS) means different things to different people. In practice, it is difficult to reach an agreed definition. It is merely a feel-good term with no actual technical meaning. Open standards are international accepted protocols (technical specifications) which guarantee interchangeability between and with other ICT-systems. Pountain (2003) defines an open standard as “a standard that is independent of any single institution or manufacturer, and to which users may propose amendments.” Another expert (Coyle, 2002) identified three key characteristics: anyone can use the standards to develop software; anyone can acquire the standards for free or without a significant cost; and the standard has been developed in a way in which anyone can participate. Bruce Perens (2004) defines open standard in the following words

“Open standards are transparent, open ended and freely implementable, and accessible over open forum”.

A proprietary standard is characterized by the fact that it is owned by some one who puts restrictions on – or can put restrictions on – users’ access and use. On the other hand, a completely open standard has the following properties:

- It is accessible and free of charge to all (i.e. there is no discrimination between users, and no payment or other considerations are required as a condition of use of the standard);
- It remains accessible and free of charge (i.e. owners will not access limit to the standard at a later date); and
- It is accessible free of charge and documented in all its details (i.e. all aspects of the standard are transparent and documented, and both access to and use of the documentation is free).

The purpose of open standards is to ensure interoperability so that different systems can interact with each other without problems. It facilitates use of the products in new areas and in new ways for the benefit of society.

C. Open Source and Open Source Software

Open Source and Open Source Software (OSS) are both a philosophy and a process. It is not a new idea. It is a philosophy describing the intended use of software and methods of distribution. Open source software is software that includes source code along with the binary version and is usually available at no charge. It is governed by a license under which anyone can access, modify, and further distribute the source code. Open source is a software development model as well as a software distribution model.

The open source movement (OSM) has been in conscious development for nearly two decades but the term “*open source*” itself has been a relative latecomer. Christine Peterson of the Foresight Institute proposed the term *open source* in late 1997 during a meeting of small group of open source movement key persons (Raymond, 2001). This group registered the domain name *opensource.org*, defined “*open source*”, developed Open Source Initiative (OSI) group, designed OSI certification, and created a list of licenses that meet the standards for open source certification. According to OSI (Open Source Initiative, 2003)

“Open source promotes software reliability and quality by supporting independent peer review and rapid evaluation of source code. To be certified as open source, the license of a program must guarantee the right to read, redistribute, modify, and use it freely”.

On the basis of the discussion and definitions given by several experts, following attributes of OSS may be listed –

- OSS is typically created and maintained by developers crossing institutional and national boundaries, collaborating by using Internet based communications and development tools;
- OSS development process follows the famous Linu's law – "*Release early, release often and listen to users*";
- Quality, not profit, drives open source developers who take personal pride in seeing their working solutions adopted; and
- Intellectual property rights to open source software belong to anyone who helps to build it or simply use it and is not locked to any single vendor or institution.

D. Open Access Scholarly Communication

Numerous definitions of Open Access (OA) scholarly communication may be found; the central tenet being that the reader does not pay for access to the research, and that the author may or may not pay for the 'making available' of such research. The key concept here is access; that research output is not expensive (i.e. there is a minimal fiscal barrier) and that research output is accessible (i.e. access to the material is not restricted in terms of physical infrastructure nor restricted by authentication systems). Scholarly communication is a broader term reflecting various processes through which scholars exchange information with each other in the course of knowledge creation. The system of scholarly communication has evolved over time since it came into existence. Open Access scholarly communication, and more specifically scholarly publication, is an important manifestation of knowledge generation and diffusion. In the context of this study, open access scholarly communication means the process through which scholars access and/or disseminate scholarly information through *Open Access Journals* (OAJs) and/or *Open Access Archives* (OAAs) as defined above.

E. SKOS (Simple Knowledge Organization System) based Subject Access System

SKOS is a W3C recommendation designed for representation of thesauri, taxonomies, classification schemes, subject-heading systems, or any other type of structured controlled vocabulary. It is part of the Semantic Web family of standards built upon resource description framework (RDF), and its main objective is to enable easy publication and use of such vocabularies as linked data (http://en.wikipedia.org/wiki/Simple_Knowledge_Organization_System). It was developed initially by July 2003 (as open-source project) within the project SWAD-E (Semantic Web Advanced Development for Europe) aimed to define a model for thesaurus compliant with most important ISOs (viz. ISO 2788, ISO 5964). Since

September 2004, the responsibility for the subsequent development was passed to the W3C and on 10 May 2005 was published the first Working Draft.

In library science, it is a common data model or a tool for sharing, organizing, presenting and linking knowledge organization systems via the Web using the resource description framework (RDF). KOS has classically been used in the LIS field as a way of indexing large volumes of documents in order to facilitate document retrieval and navigation. The advent of SKOS now enables the construction of KOS that can be used to index documents and share terminologies on the web. Most KOSs typically contain hierarchical categorizations of concepts, these categories are generally designed with a particular application in mind. One common type of application is a document navigation system where categories are organized in such a way to improve how users browse a document collection. The following are the advantages of SKOS based subject access system-

- Provide a low-cost migration path for porting existing organization systems to the Semantic Web/Data Web;
- Publication of knowledge organization systems;
- Enable easy publication of controlled structured vocabularies for the Semantic Web;
- Provide a lightweight, intuitive conceptual modeling language for developing and sharing new KOSs;
- Mapping support;
- Significant take up and usage;
- Web-oriented representation;
- Re-use & sharing of concepts and their descriptions;
- Linking between concepts from different contexts;
- Extensibility; and
- It can be used on its own, or in combination with more-formal languages such as Bengali

All digital libraries use one or more KOSs and ranges from authority files to classification schemes, thesauri, and ontologies. In IDRs environment, resources are organized in many ways (as stated in section 4.2.1.2 of chapter 4) and no unique system has been developed for organizing and presenting IDR resources in proper perspectives. So, here is the need to use ontology driven SKOS based subject access system for presenting IDR resources in a structured way. Though representing KOS (classification systems) on the Web for publication, presentation and exchange continues to be a challenge within the SKOS framework. The incorporation of Indic script based KOS in any repository system and transformation or implementation of KOS into Web-enabled format is necessary to meet the subject approach of the users. This research work has selected Dewey Decimal Classification (DDC) (DDC 22nd edition – up to 3rd summary) as KOS and modified it in Bengali (as demonstrated in section 5.4 of chapter 5). This KOS has been incorporated in BURA software framework and integrated with administrative interface as well as user interface so that it can be used at the time of indexing and searching.

1.8 Conspectus

The structure of the research study falls into three core parts and includes a total of seven chapters as outlined below. The three parts are as follows:

- A. A theoretical background that establishes need of conceptual model and based software framework which supports distributed, integrated and Bengali language based IDR system;
- B. An empirical investigation that establishes features, components, architecture of an IDR system or model and develops a software framework on the basis of that model through the application of a group of FLOSS based software, open standards and Universal character set; and
- C. Analytical discussion on perceptiveness of features and facilities of the Unicode compliant and FLOSS based software framework in managing various facets of IDR system, and accessing IDR resources and services related with academic institution.

The theoretical background comprises three chapters. Chapter 1 primarily concerns with background of the research and statement of research problems taken up for this study along with its associated elements. It introduces the concept of scholarly communication and OA before stating the problem of the study. The chapter also presents the aim and objectives of the study, research questions, significance of the study, definition of key concepts, a brief outline of the research design, methodology used to carry out this study and the thesis structure.

Chapter 2 furnishes a review of the research results with reference to recent research trends on various facets of IDR system and Indian scenario in the domain of repository movement. It emphasizes the need of present research and identifies limitation of the present system in the literature. The purpose of this review is to position the study within similar works as well as explore the available knowledge in the study discipline.

Chapter 3 presents basic information regarding IDR such as history, features, major initiatives and projects in national and international level. This chapter also explains existing IDR system in India and highlights on problems of the system along with tentative solutions.

Chapter 4 describes policy decisions regarding several key issues such as contents, copyright and licensing model, quality of contents, access to contents, metadata, preservation, multilingual resource management and back up etc. It describes

internationally accepted metadata standards for different types of objects such as learning objects, dissertations and theses etc, and describes different domain specific open source software to facilitate a model where all software can interact with each other seamlessly. The chapter also describes three clusters and software associated with it. It then concentrates on the selection of IDR software on the basis of global parameters to develop a software framework as proposed in the model. The chapter also describes different harvesting software and develops harvesting software framework for BURA that support federated searching in a single-window search interface.

Chapter 5 deals with the practical implementation of the software framework of the model BURA. It deals with the development and customization of the software framework to support Web-enhanced and Unicode-compliant distributed IDR system for the University of Burdwan. This integrated Web-enabled model (BURA - Burdwan University Research Archive) is based on open standards following open source software. This chapter concerns with the customization of user interface in Bengali as well as integration of social software like Blog, RSS in BURA software framework. It describes in details designing and development process of metadata harvesting framework for metadata extraction from different OAI-PMH compliant repositories. The chapter demonstrates the development of ontology driven Indic script based subject access system in the proposed software framework and generates an ISO image for utilization by other institutes or universities as an off-the-shelf product.

Chapter 6 describes different services offered by the system. It explains with the help of various snap shots, the steps involved in administering DSpace, like creating and maintaining Communities, Sub-communities, Collections, E-People; authorizing E-People to submit to the Collections; creating and maintaining E-Groups, service model, searching and browsing of multilingual objects, resource harvesting mechanism etc. The chapter highlights on simple and advanced search techniques including browsing and searching of different Communities and Collections of the software model. It shows the process of browsing, searching and retrieving of resources in Bengali language. This chapter also shows the process of browsing and searching specific subject using subject access system to enhance subject categories. This chapter also describes mechanisms of searching and harvesting metadata from multiple OAI-PMH compliant repositories and deals with integration of social software in BURA software framework.

The chapter 7 is the final chapter of the thesis. In this chapter, the findings arising from the previous six chapters are discussed, common threads gathered and matters of distinction highlighted. Also discusses the limitations inherent in this body of research, identifies possible areas of further study and presents the concluding remarks. Key conclusions are then drawn as to the implications and presents the overall summary and recommendations of the study, including areas for further study.

Chapter 2

Literature Review



“If you have an apple and I have an apple and we exchange these apples then you and I will still each have one apple. But if you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas.”

George Bernard Shaw (Phi Kappa Phi, 1952)

Structure

- 2.0 Introduction
- 2.1 Facets of Institutional Digital Repository (IDR) System
 - 2.1.1 Advocacy and Promotion
 - 2.1.2 Content Recruitment
 - 2.1.3 Digital Preservation
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- 2.2 Indian Scenario
- 2.3 Findings of Literature Review: Gaps and Overlaps
- 2.4 Need of Present Research

2.0 Introduction

The literature review aims to place the current investigation within the existing research literature, both in terms of how the literature review has impacted the investigation, and how the research undertaken will contribute to the professional understanding of the subject. Conducting a literature review for relevant research on the open access repositories (institutional repositories in particular), was a challenge in itself. A large amount of the work done in these subjects has theoretically explored the issues but there is little research on the actual instances. This research study attempts to give a clear idea to the topic selected for the study. This research is a relevant topic with current importance. Because there is no much study are conducted earlier in this area. As IRs is still in a growth phase, the building and development of an IR has yet to be addressed empirically in the literature (Swanepoel, 2005) and the literature review may be used as an integral part of the research process in particular when the research topic is relatively young, providing an initial foundation for a new research topic (Levy & Ellis, 2006). As this is a relatively new area of enquiry, one of the main attractions is that there is plenty of scope for research but one of the drawbacks is discovering the relevant literature. It enables one to be aware of the past and current trends in any particular branch of research and devotes to examine the review of works relating to various aspects of repository movement through out the world. This review is not just an analysis of the relevant literature that was collected, but it is also an exercise that attempts to describe the key elements and characteristics of this mainly uncharted territory. This literature review therefore, not only analyses and synthesizes the available previous work on the subject (Levy & Ellis, 2006), but also gathers and collectively overviews literature on these issues providing an initial foundation for this new research topic.

The purposes of literature review is two fold – (i) to carry out to identify, locate and synthesize research reports, articles, books and Web-resources; and (ii) to put this research oriented book into proper perspectives. Under such circumstances, the objectives of this chapter on literature review are:

- To discuss different facets of institutional digital repositories (IDRs) and shows how they are related to the development of IDRs;
- To review recent research trends on various facets of IDRs;
- To examine Indian scenario in the domain of IDRs;
- To identify gaps and overlaps of existing literature, if any; and
- To explain the need of present research for the University of Burdwan.

Literature search for this study has been done by examining general and specialized bibliographic tools, indexing and abstracting tools, directories, Web portal of journals, electronic databases, and other appropriate references tools.

2.1 Facets of Institutional Digital Repository (IDR) System

This particular section has discussed some of the facets involved in setting up and running an IDR system. This research work divides the whole array of digital repository into two major sections for analyzing the research trend of the field under study. The first section examines the different facets identified throughout the literature and the second section is confined to India and reviews existing literature on Indian context.

2.1.1 Advocacy and Promotion

One aspect of the literature that is directly related to the ‘back-end’ processes of IR management is the discussion of advocacy, marketing for IRs. As IRs, OA, and self-archiving are unfamiliar and relatively new concepts to the academic community, advocacy has become a crucial aspect of any IR project (Chan, Kwok & Yip, 2005). Leary, Lundstrom & Martin (2012) rightly pointed out that continued marketing leads to continued growth of the IR, making it all the more necessary that the IR runs smoothly. There are a number of strategies (e.g. brochures, campus newsletters, campus newsletters/newspapers etc.) that existing institutional repositories have used, or can use to encourage acceptance and uptake of their repository (Mark & Shearer, 2006; Horwood et al., 2004; Ashworth, Mackie & Nixon, 2004; Pinfield, Gardner & MacColl, 2002; Barton & Waters, 2004–2005). Setting up an archive is one thing, getting users to participate in its ongoing development is quite another. Many authors (Jones, Andrew & MacColl, 2006; Mackie, 2004; Markey et al., 2007; Bevan, 2007; Greig, 2004) described several methods to populate IR. Gierveld (2006) considers IR as a product that needs to attract a market. The other experts (Dill & Palmer, 2005) proposed some promotional ideas for the implementation of an institutional repository. Another study (Morgan & Team IDR, 2006) identified a number of things about promoting awareness, marketing, and advocacy on issues surrounding scholarly communication. This study (Weenink, Waaijers & Godtsenhoven, 2007) investigates the challenges in populating repositories particularly in European context based on six good practices that influences the development of IR.

Johnson (2008) is of the view that ‘advocacy is a route to achieve the crucial goal, real cultural change’. Markland & Brophy (2005) are of the view that for an institutional repository to be successful, cultural change must be achieved through advocacy or ‘getting the right message to the right people with the tone and contents varied by audience’ (Johnson, 2008). Several other experts (Aschenbrenner et al., 2008; Lynch, 2003; Westell, 2006) put emphasis on collaboration and participation of stakeholders or community members as it may be a new concept to them. The stakeholders include both academic and non-academic staff; those involved in

teaching or research; and both postgraduate and undergraduate students. Each of these groups contains potential authors and readers of material. The contributions of authors, in particular, are critical to the success of an IDR. Thibodeau (2007) puts emphasis on collaboration among stakeholders and concluded that if an institutional repository works in isolation, it might signify failure because it does not share and transfer knowledge.

A number of different advocacy strategies can be used, including top-down and bottom-up, blanket and targeted approaches (DRIVER, 2008). But there is a serious lack of visibility (McKay, 2007; Davis & Conolly, 2007) and usage (Kim, 2006; Woodland & Ng, 2006) among authors and information seekers. Ignorance among researchers about copyright and plagiarism issues may restrict adoption of open access repositories (Suber, 2008; Abrizah, 2009). Another group of authors (Davis & Connelly, 2007; Watson, 2007) put emphasis on faculty attitudes, motivations, and behaviors for non-participation in institutional repositories and encourage academic communities to deposit their work. Other experts (ALPSP, 2002; Bentum, 2001; Gonzalez & Porcel, 2007) reported that quality of contents is another problem of faculty participation. For faculty and students, JISC stresses the advantages of “free sharing of information, encouraging collaboration and the widespread communication of institutional education and research activity” (JISC, 2005). A few other experts (Shearer, 2003; Kim, 2006) suggest that the success of IRs will be determined eventually by their uptake and use by researchers and argues that one of the measures for IR usefulness is contribution of contents. And the repository will need to be effectively marketed to members of the university community in order to acquire contents (Kiran & Chia, 2009). Other experts (Hubbard, 2003; Ware, 2004) identified cultural rather than technological factors limit the use and development of IRs. Another study (Bailey et al., 2006a) reported that contents recruitment was also one of the biggest challenges in IR development.

Another report (Gonzalez & Porcel, 2007) is in support and Pickton & McKnight (2006) put emphasis not only on academic staff but also on library staff and mentioned possible mechanisms for promotion of IR. Supporting staff in deposition process through the use of a system of ‘*mediated deposit*’ is one solution. Another study (Jenkins, Breakstone & Hixson, 2005) discussed in detail various attempts that they had made at the University of Oregon to increase user awareness about their IR. They further suggested that reference librarians have a vital role to play in helping to recruit authors to submit their contents to IR, as well as in educating users to search such repositories effectively and retrieve the scholarly contents from them. Horwood et al. (2004) briefly outline how they do this at the University of Melbourne, and refer readers to Nixon’s (Nixon, 2002) paper for further details. Ashworth, Mackie & Nixon (2004) also reported that they had to do this at the University of Glasgow.

Providing incentives such as awarding prizes to top depositors has also been found to be effective for the development of IR (Cullen & Chawner, 2008). Xia et al. (2012)

showed how this strategy for encouraging faculty to participate is working in University of Minho in Portugal. Another useful report (House of Commons Science and Technology Select Committee, 2004) recommended for compulsory deposit policy of public funded research of all levels of education. Another group of authors (Pinfield, 2005; Harnad, 2006a, 2006c; Swan & Brown, 2005; Sale, 2006b; Suber, 2006; Rowland et al., 2004) strongly support this view. Peter Suber (Suber, 2008) in another paper recommends three principles, two of which relate specifically to institutional repositories. The first principle suggests that the university provide open access to all research output. He recommends the use of mandatory language regarding university expectations; faculty and staff education and assistance; and incentives to use the repository.

2.1.2 Content Recruitment

“Recruitment of content, not technology, is the greatest barrier to success” (Gibbons, 2004b) and is the central issue for most IRs (Westrienen & Lynch, 2005). Many libraries are facing the challenges to develop and manage contents of an IR. Studies consistently report that recruiting contents is difficult (Heery & Anderson, 2005; Davis & Connolly, 2007; Salo, 2008). Several studies (Westell, 2006; Sale, 2006a; Jingfeng, 2006; Kingsley, 2008) identified several questions and issues (mandate; integration with planning; funding model; relationship with digitization centers; interoperability; measurement; promotion; and preservation strategy, personal name identification etc.) those need to be considered before recruiting contents for an IDR system. Recruiting contents for IRs has been difficult strategies that IR staff have enlisted (Crow 2002b; Chan, 2004; Shearer, 2004, 2005; Mackie, 2004; Barton & Waters, 2004–2005; Jenkins, Breakstone & Hixson, 2005; Graham, Skaggs & Stevens, 2005; Chan, Kwok & Yip, 2005; Bell, Foster & Gibbons, 2005). Contents recruitment was also identified as one of the biggest challenges in IR development (Bailey et al., 2006a). He also identified several motivating factors in the ARL survey. These motivators include implicit values of librarianship; collecting and preserving an institution’s scholarship and ensuring that it is accessible. Carr & Brody (2007) state that the key to a successful repository is sustained deposits. To achieve sustained deposits, community engagement is necessary (Henty, 2007). A few studies (Davis & Connolly, 2007; Foster & Gibbons, 2005; Rieh et al., 2007b) reported that faculty’s lack of understanding of the IR as one of the problems of recruiting contents. In the same article, Davis & Connolly (2007) concluded that use of IR by faculties depend on disciplinary cultures and reward structures while Foster & Gibbons (2005) mentioned three ways (deposit process, created researcher pages for faculty, promoting IR in the faculty’s language etc.) of promoting contents of IR. The other experts (Xia et al., 2012) identified additional issues that prevented many faculty members from contributing to their institution’s repository included limited technical skill levels and a lack of additional time to deposit research articles.

Aggressive marketing (Troll Covey, 2011) and providing value-added services are necessary to increase faculty participation (Bankier & Perciali, 2008). Giesecke (2011) is not enough; additional incentives must be built in as well. The other studies (ALPSP, 2002; Bentum, 2001; Gonzalez & Porcel, 2007) reported that the process depends on quality of contents.

Another group of authors (Hassen, 2006; Mark & Shearer, 2006; Kim, 2006) identified and discussed several others recruitment strategies (accessibility, publicity, professional recognition, contents harvesting, usage, feedback) for an IR. Jenkins, Breakstone & Hixson (2005) described recruitment approaches through creation of user communities by the librarian. Genoni (2004) suggests that collection development plans should be developed to prioritize contents added to a collection. Local efforts to embed the repository within the research processes of an institution are not always successful. Feijen et al. (2007) suggest that what is needed is the embedding of repository use in research and research publication processes on a large scale. Another study (Pettijohn & Neville, 2003) reported how libraries have responded to this paradigmatic shift by pioneering new collection development strategies, and then examines the changing responsibilities of collection development librarians in an electronic environment.

2.1.3 Digital Preservation

Digital Preservation is another critical issue of digital library environment and has been currently a major concern for the information management, technological and scientific communities in all domains. The issue about addressing long-term access to contents is very strong in the literature and preservation is perceived as one of the key issues that can determinate the success of IDR. The initiative to support digital preservation and asset management in institutions has been discussed in several studies (Pinfield & James, 2003; Smith & Moore, 2007; Weenink, Waaijers & Godtsenhoven, 2007; Wheatley, 2004; Gibbons, 2004). Several key initiatives were addressing digital preservation issue such as SHERPA (<http://www.sherpadp.org.uk/index.html>) and the Digital Preservation Coalition (DPC) were the most prominently initiatives. The DPC (<http://www.dpconline.org>) offers a wealth of information and practical guidance on digital preservation. JISC Digital Preservation and Records Management Programme launched the Digital Curation Centre and support the Digital Preservation Coalition, which aims to develop different approaches to achieve long-term preservation (Carpenter, 2005). Another initiatives has been taken by Stanford University developed the LOCKSS (Lots of Copies Keeps Stuff Safe), an OAI compliant software system that exploits peer-to-peer networking technology to maintain electronic publications copies (Eaton, 2005). The CLOCKSS initiative (jointly taken by Library of Congress and Stanford University) is a collaborative, community initiative to build a trusted, large-scale, dark archive. It is intended to

provide a decentralized and secure solution to long-term archiving, based on the LOCKSS technical infrastructure (<http://www.lockss.org/clockss/>). Another excellent source for learning about digital preservation was the PADI (Preserving Access to Digital Information) site published by the Australian National University. The site offers a concise guide to the most often discussed strategies for digital preservation – migration, adherence to standards, encapsulation and emulation—along with additional resources for in-depth information (<http://www.nla.gov.au/padi/about.html>). Another approach is taken by Portico (<http://www.portico.org/>) which aims to preserve e-journals.

Digital preservation is a complex process and there are still many unsolved issues which make it a challenging task for IDR administrators. Several authors discussed the issues and challenges of digital preservation facing institutional repositories (Jones, Andrew & MacColl, 2006; SPARC, 2002a; Bradley, 2005; Yakel, 2007; Cordeiro, 2004; Lin, Ramaiah & Wal, 2003) highlighting current research and standards efforts. A few authors (Hockx-Yu, 2006; Lor, 2005; Patel & Simon, 2007) described various other issues (i.e. technical, organisational, economic, political, legal & ethical) and another report (PALS report) explained different approaches (Ware, 2004) of digital preservation. Another important issue such as fear of technological obsolescence and need of preservation was discussed in few articles (Pinfield & James, 2003; Jones & Beagrie, 2002).

Preservation of digital format or file format is more complex than that of paper-based information, mainly due to the rapid advances in technology. The issues raised by the long-term preservation of digital objects are very far from solved. There are clear differences between file formats because a file format that is good for access today may not be a format that is easy to migrate, but a format that is easy to migrate may not be easy to read. Some IR systems are format-neutral—the system accepts deposits of any digital format whereas other systems are hard-coded— to only accept formats of certain types. This vital issue has been discussed in several studies (Abrams, 2004; Rosenthal, 2010; Thompson, 2010; Hitchcock & Tarrant, 2011; Jones, Andrew & MacColl, 2006; Bailey et al., 2006a). Another group of authors (Curtis, 2006; James et al., 2003; Weenink, Waaijers & Godtsenhoven, 2007; Morgan & Team IDR, 2006) argued different file format for different types of digital objects. Several other experts (Aschenbrenner & Kaiser, 2005; Pinfield, 2002; Cervone, 2004) concluded that PDF as preferred format is likely to guarantee the preservation of the document as is widely used in many repositories. Smith (2002) compared the changeability of the digital format with a volatile and fickle object and emphasizes that society in general does not understand or appreciate the complexity of the problem.

Another issue highlighted in the literature is sustainability and long term preservation of digital object (Bullock, 1999; Harmsen, 2008; Hockx-Yu, 2006; Stanescu, 2005; Wheatley, 2004). Long-term preservation of scholarly contents is an essential role of IRs (Lynch, 2003). Not a one-time event, long-term preservation consists of

specific functions such as ingesting digital objects in which metadata is created, storing such objects and associated metadata, monitoring technology obsolescence, and evaluating the usage of digital objects (Fyffe et al., 2004). Shaon & Woolf (2011) investigates the requirements for ensuring sustained access to environmental data from the perspective of a preservation-aware SDI.

Jones, Andrew & MacColl (2006) stated that ‘one objective of many repositories is to provide items in perpetuity’. The APSR (Australian Partnership for Sustainable Resources) discussion paper on sustainability issues by Bradley (2005) goes into considerable detail on issues related to sustainability and long-term preservation, and steps needed to achieve this. The SPARC (2002b) report is in support and addresses preservation in perpetuity in more detail. Another paper addresses the question of whether or not e-prints should be preserved (Pinfield & James, 2003). Another group of authors (Calanag, Tabata & Sugimoto, 2004; Dondorp & Meer, 2003; Ware, 2004) described different projects and techniques of digital preservation along with relevant preservation standards and best practices for digital objects. Another survey report (Li & Banach, 2011) reveals the challenges and opportunities of implementing digital preservation for IRs in a complex environment with rapidly evolving technology and examines the current practices and standards of digital preservation of IR materials.

Other experts (Eden & Feather, 1996; Calanag, Tabata & Sugimoto, 2004; Patel & Simon, 2007) argued for a national preservation policy for long term sustainability of digital data. Besek et al. (2008) reviewed current copyright and related laws and their impact on preservation and recommends for drafting national policies and adapting laws to allow digital preservation.

Many IRs employed shared standards such as the Open Archival Information System (OAIS) reference model and the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH). The OAIS model provides a comprehensive framework of all the functions required for digital preservation including ingest, storage, retrieval, and long-term preservation of digital objects. And OAI-PMH is a mechanism for harvesting extensible markup language (XML)-based metadata from repositories, and it therefore makes possible interoperable search and retrieval among repositories (Branin, 2005).

The other experts (Calanag, Tabata & Sugimoto, 2004; Chilvers & Feather, 1998; James et al., 2003; Cantara, 2006) shared their experience of making metadata as another solution of digital preservation. Lavoie & Gartner (2005) provided a definition of preservation metadata, described its role in the digital preservation process, and reviewed a number of existing preservation metadata initiatives, with an emphasis on identifying points of convergence and divergence among them. Another researcher (Day, 1997; Groenewald & Breytenbach, 2011) suggests how the concept of metadata could be extended to provide information in the specific field of digital preservation. Other researchers (Pugin, Hankinson & Fujinaga, 2012) discussed a

new Web-based cataloguing system for the global music heritage materials. Another expert (Goh et al., 2006) mentioned that preservation not only refers to the preservation of metadata but also to the use of quality control measures to ensure integrity, and persistent documentation identification for migration purposes.

Smith (2002) discussed several preservation techniques and mentioned that there are at least four approaches to preservation (migration; technology preservation; emulation; and persistent object preservation) and there is significant research going on under nine headings. Another expert (Kuny, 1997) identified the gap in terms of the three main methods of preservation namely technology preservation, technology emulation and information migration. Other expert (Granger, 2000) describe and focus on "Emulation" as one of the technique of preservation and Wheatley (2001) on "Migration" as another technique. Han (2004) suggested preservation of digital objects through software. Another study (Jantz & Giarlo, 2005; Chen, 2007) described architecture and technological aspects and put emphasis on new methods, policies, standards, and technologies of digital preservation that can be integrated into an operational digital preservation framework. Another group of authors (Hitchcock et al., 2005; Ferreira, Baptista & Ramalho, 2006) described preservation service architecture. Stanescu (2005) also remarks how implementing models for achieving preservation must be a priority: he claims that preservation plans should be based on objective analysis of risk trends (for file types, software and hardware) rather than on individuals' opinions and experiences. Another project at the University of Michigan has developed its own preservation plan and provides three levels of support for scholarly materials and describes best practices for different file formats (Deep Blue, n. d.). The other authors describe the set of components that are necessary to build a Service- Oriented Architecture (SOA) to enable cultural heritage institutions to carry out digital preservation with minimum human intervention (Ferreira, Baptista & Ramalho, 2006). Another group of authors (Hitchcock et al., 2005, 2007; Dondorp & Meer, 2003; James et al., 2003) described different OAIS models. Another blue book (Consultative Committee for Space Data Systems, 2002) has more detailed recommendations about best practice and appropriate work flows for each stage of the preservation process. Another question is who should be responsible of this duty? Cervone (2004) identifies two stakeholders: publishers and librarians. The SPARC report addresses preservation in perpetuity in more detail and proposes to lay the task in the hands of librarians, those professionally prepared (Crow, 2002a).

2.1.4 Interoperability and Open Access (OA)

Crow (2002a) reported that IRs is by their nature usually designed to be OA and a primary goal is to be able to link up with other similar archives. He further suggested that systems (IR) must be able to support interoperability and able to harvest metadata

through multiple search engines and other standard discovery tools in order to provide broader access to the academic and research community, users outside the institution. It should be interoperable, which refers to the capability of a computer hardware or software system to communicate and work effectively with another system in the exchange of data, usually a system of a different type, designed and produced by a different vendor (Reitz, 2006). Westell (2006) states that interoperability indicates openness on behalf of the institution or the library which is willing to contribute to national and international scholarship.

Several research studies (Hunter & Guy, 2004; Horwood et al., 2004; Ginsparg, Luce & Van de Sompel, 1999; Van de Sompel & Lagoze, 2000; Mazurek et al., 2006; Eaton, 2008; Alipour-Hafezi et al., 2010; Khazraee et al., 2011; Miller, 2004; Westell, 2006) explained the necessity of OAI Protocol for Metadata Harvesting (OAI-PMH) in digital repository environment and described Open Archives (OA) as a tool by which interoperability can be achieved (Alexander & Gautam, 2004). Interoperability between digital repositories can be achieved in various ways and on various levels. “To achieve this, the parties need to agree on the structure, the syntax and the semantics of the data and/or metadata objects, and they need to either comply with common formats or to provide a means for metadata mapping and/or for object conversion” (Aschenbrenner & Kaiser, 2005). Suleman (2001) reported that the success of making interoperability for digital library depends on vigilance in specification of the protocol as well as standardization of implementation. Peset et al. (2007) highlighted the situation of the development of repositories that use the Open Archives Initiative (OAI) protocol for data collection.

The other experts (Jerez et al., 2004) focused on the multi-faceted use of the OAI-PMH to access stored contents in repository architecture. Bell & Lewis (2006) described OAI-PMH as a part of automated export/import process of software components and being a part of the process it encourages the preservation of multiple copies for safety of the contents. Another group of authors explained its metadata formats (Van de Sompel et al., 2004; Van de Sompel, Young & Hickey, 2003) whereas others expert explain its origins in promoting E-Prints, the details of its technical standard for metadata harvesting, the applications of this standard (Lagoze & Van de Sompel, 2001). Warner (2001) showed in practical through Perl code how OAI-PMH can be used to expose and harvest metadata from Archives. Prom (2003) outlined a method for exposing deep, hierarchical metadata from encoded archival description (EAD) files and assesses some theoretical and practical issues that will need to be confronted by institutions choosing to provide or harvest OAI records generated from EAD files. Kaczmarek & Naun (2005) explained the construction of a meta search service model based on the Z39.50/OAI Gateway Profile and concentrated on the technical aspects of building such a service model rather than on the usability of the interface or on questions of interoperability at the metadata level. Van de Sompel & Lagoze (2000) described the Santa Fe Convention of the OAI, a set of relatively simple but potentially quite powerful interoperability agreements that

facilitate the creation of mediator services. Pieper & Summann (2006) reported the activities of Bielefeld University Library in establishing OAI based repository servers and provides an overview of the functionalities of BASE (Bielefeld Academic Search Engine) and gives insight into the challenges that have to be faced when harvesting and integrating resources from multiple OAI servers.

2.1.5 Legal and Intellectual Property Right (IPR)

Intellectual property and copyright has become a critical issue in digital environment. Intellectual property and copyright legislation are major and controversial issues and present a number of challenges for institutions implementing repositories (Jones, Andrew & MacColl, 2006; Jones, 2007). They have discussed this issue and suggested that the institution may be one of three legal positions: Common carrier - absolute immunity; Distributor - not subject to liability unless they have specific knowledge; and Publisher - liable for what they choose to publish. The copyright issues have been extensively reviewed in RoMEO (Rights METadata for Open Archiving) project (Gadd, Oppenheim & Proberts, 2003a). This RoMEO Project has compiled a list of many journals' "Copyright Policies" about "self-archiving." The project investigate the rights issues surrounding the 'self-archiving' of research in the United Kingdom academic community under the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH). In another paper, they recommend the use of Creative Commons (CC) licenses to express the rights attached to individual research papers (Gadd, Oppenheim & Proberts, 2004). Another project "*A guide to developing open access through your digital repository*" covers important issues (e.g. licensing, technical considerations such as software and metadata) relating to copy right and provides valuable directions to the repository managers ((Pappalardo & Fitzgerald, 2007). This report contains important sections that discuss pre-prints and post-prints and copyright issues. 'Third party copyright' was recently raised as an issue by several people representing institutions that are in the process of implementing repositories. This vital issue requires more focus hence the creation of this section and has been discussed very briefly in the literature (Jones & Andrew, 2005; Gadd, Oppenheim & Proberts, 2003b).

One of the more obvious issues in digital library environment is copy right issue both for publishers and for authors whether to deposit their research into the repository. Willinsky (2002) reviewed the specifics of publishers' contracts with editors and authors, as well as the larger spirit of copyright law. The Study (Swan & Brown, 2005) noted that authors are not always aware of the full copyright implications of their work and had fewer concerns over the use and potential abuse of their work (i.e. plagiarism, integrity and commercial use) (Gadd, Oppenheim & Proberts, 2003c). In another article they concluded that material placed in an IR will be owned by the institution, the author or, in the case of a post print, a publisher (Gadd, Oppenheim &

Probets, 2003d, 2003e). Another study (Hoorn & van der Graaf, 2006) report that 71% prefer to keep copyright, 2% prefer to transfer copyright to publishers, 23% are neutral about the choice between the two, and 4% do not know.

Another legal issue is plagiarism and most of graduate students and research supervisors expressed concern about the risk of plagiarism (Copeland, Penman & Milne, 2005; Greig, 2005; Friend, 1998; Jewell, Oldfield & Reeves, 2006). They further argued that plagiarism and misuse is facilitated by making theses and dissertations electronically accessible through the web.

Copyright or intellectual property right (IPR) is seen as a significant barrier often confronting institutions, which have adopted ETD (Electronic Theses and Dissertation) programs (Copeland & Penman, 2004; Leung, 2005). The issue of copyright is critical to the development of IRs, especially with regard to journal articles and materials for which others may own the copyright. Greig (2004) provides a useful overview of how to populate an IR and stay within the legal limits (<http://www.arl.org/sparc/meetings/ir04/presentations/greig.html>). Another Study (Morgan & Team IDR, 2006) recommended that copy rights for things like articles, working papers, technical reports, etc. are owned by the faculty and students who wrote them until they are transferred in writing.

Another report (ALPSP, 2002) suggests that authors and faculties are now aware of the IPR issues and they consider it important to retain copyright with them. They don't want their materials to be used by others and want to keep self-archiving rights and rights for personal educational use with them (Kling & McKim, 2000; Bennett, 1999). Probets & Jenkins (2006) pointed out that the complexity of IPR is of great concern to all involved with the management and accessibility of intellectual property whereas Denning (1995) reported a few cases of plagiarism of digital material. Another study (Weenink, Waaijers & Godtsenhoven, 2007; Joint, 2006a) outlined some useful insights into how to manage copyright and other intellectual rights aspects of digital library collections relevant for digital repositories development. Lynch (1994) suggested solutions like dedicated server, document digest algorithms, and cryptographic signatures to overcome some of these problems. The working librarians find it a difficult task to protect author's right in proper way. Librarian must be well acquainted with the IPR issues, particularly rights management legalities for developing IDR. Several authors (Chepesiuk, 1997; Collins & Berge, 1994; Crawford, 1998; Jasperse, 1994; Perryman, 1991; Sasse & Winkler, 1993; von Ungern-Stenberg & Lindquist, 1995) have discussed this issue and addressed various problems faced by the librarians in the digital library environment. Hoorn (2005) put emphasis on and considers ways librarians can support scholars in managing the demands of copyright so as to respond to the needs of scholarly communication. The other authors (Besek et al., 2008) reviewed current copy right and related laws and their impact on preservation. The study also recommends for drafting national policies and adapting laws to allow digital preservation. The Audit Checklist (RLG &

NARA, 2005) points out that it is the responsibility of the IR to have a mechanism in place to track and verify the rights and restrictions applicable to a digital item.

2.1.6 Metadata

Metadata is structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage an information resource (National Information Standards Organization, 2004). Standardized metadata is important because it enables end users to easily and effectively search, find and retrieve information from the repository (Pinfield, Gardner & MacColl, 2002; Jones, Andrew & MacColl, 2006; Jones, 2007). A number of decisions need to be made by the digital repository regarding metadata of various types. 'Administrative, descriptive, technical, structural and preservation metadata, using appropriate standards, are used to ensure adequate description and control over the long term' (DCC, 2008). Several authors (Burk et al., 2007; Dunsire, 2008; Simeoni, 2004) discussed issues, principles and methods of metadata creation and harvesting in digital repository. Burnett, Ng & Park (1999) described and compared the contributions towards the evolution of metadata by both the fields' library science and computer science. Weibel (1995) provided one of the first major introductions to the basic concepts of metadata usage in the digital library (DL) environment. Other experts (Chilvers & Feather, 1998; Calanag, Tabata & Sugimoto, 2004) discuss role of metadata in preserving digital data. A few other experts (Robertson, 2005; Ochoa & Duval, 2009; Park, 2009) focused on quality of metadata. Currier (2008) gives an overview of current initiatives in standards for educational metadata. Another expert (Zschocke & Beniest, 2011) introduced a process for assuring the creation of quality educational metadata based on the ISO/IEC 19796-1 standard to describe the agricultural learning resources resources in the repository of the Consultative Group on International Agricultural Research (CGIAR).

Gibbons (2004) reported that existing IDR systems differ widely in the handling of metadata. Some repositories implement additional or extended metadata schemas for domain specific datasets and others have used or adapted existing schemas, such as Dublin Core or MARC. In some systems, the metadata schema is hard-coded, and others support some degree of modification. Some IRs can provide for a different metadata schema with each collection, and others require the same metadata schema across the entire repository. He concluded that in the end it is up to the institution to select what the best schemas for their needs and to decide which to support in their repository. A UKOLN article outlines a checklist of guidelines to assist organizations in choosing a metadata schema for a repository (<http://www.ukoln.ac.uk/qa-focus/documents/briefings/briefing-63/html/>). Another expert (Park & Richard, 2011) assessed the metadata element sets of electronic theses and dissertations that are currently used at Canadian academic institutional repositories. Day (1999) returns to

the topic of an earlier metadata column and reviews recent activities related to the development of metadata schemes for digital preservation. Other researchers (Groenewald & Breytenbach, 2011) investigated the awareness about digital preservation and discussed the use of metadata principles and the implementation of tools for the preservation of documents stored on personal computers. Dappert & Enders (2008) showed how it could be used a combination of METS, PREMIS and MODS to represent eJournal Archival Information Packages in a write-once archival system and reported the use of METS structural, PREMIS preservation and MODS descriptive metadata for the British Library's eJournal system.

2.1.7 Models

Libraries have been struggling with how to fund the IDR in a sustainable way. Branin (2003) in his draft paper on Institutional Repositories in 'Encyclopedia of Library and Information Science' described conceptual model and standards for a digital repository and basic components of an IR. Recent research (Rieh et al., 2007a) indicates that there are a wide variety of ways, many informal, that this is being accomplished. Prosser (2003a, 2003b) describes IR as a new model that is taking advantage of the new technology and discusses a possible future for scholarly communications. Swan et al. (2005a, 2005b) describe a delivery, management and access model for e-prints and OA journal contents for UK higher education. Rowland et al. (2004) reviewed possible models for implementing OA to research reports in IRs and OA journals. They concluded that 'harvesting model' was preferable to either a centralized national service or a completely decentralized service for the UK.

Developing sustainable business model is a critical concern for any publishers and McLennan (2009) focuses on the overview of business models for OA journals as stated in SPARC report entitled '*Income Models for Open Access: An Overview of Current Practice*'. Cockerill (2006) discusses various issues related to economically sustainability of OA publishing. The other researchers (Bird, 2008; Albanese, 2005) discuss the paid OA initiative and started experimenting with an '*author-side payment*' OA model. IR as a management model (Kim, 2007) and as a consortial model (Moyle, Stockley & Tonkin, 2007) could be a guiding tool for others to vitalize their existing IRs has been highlighted in the literature. Peters (2002) is in support and provides a good overview of the various types of digital repositories-individual, discipline-based, institutional, consortial and national and discusses the value of repositories maintained by consortia as an alternative model. Ware (2004) in the PALS report and Jones, Andrew & MacColl (2006) note the early successes achieved by repositories in physics (arXiv), computer science (Networked Computer Science Technical Reference Library), economics (EconPapers), cognitive science (CogPrints) and more notably in the PubMed central model. Another study (Crow, 2002a) identifies four components of scholarly publishing: registration, certification,

awareness and archiving. Saracevic (2000) proposed a conceptual evaluation model for digital libraries, and emphasizes both the researcher's and the librarian's perspective. He further identified few criteria and grouped them into four categories: usability involving studies of contents, process and format; system features including technology performance and process/algorithm performance; usage consisting of material use and usage patterns; and ethnographic and others. Another study by Itsumura (2000) proposed other evaluation frameworks with the four categories of contents, system, uses/users and management/policy while Larsen (2002) describes the criteria of three categories excluding management and policy.

2.1.8 Multilinguality

Digital Libraries (DLs) with especially in online network environment are expected to serve multicultural and multi lingual communities (Chen, 2007). Library community has been dealing with multilingual access to information since 1970's (Brendler, 1970) and information professionals are concerned about providing multilingual information services to the user communities (Zielinska, 1976). The most important feature of any multilingual digital library system is that it allows browsing and searching across two or more different languages. It brings together collections from various countries, regions, cultures and provides access on a global scale (Yang, Wei & Li, 2008; Maeda et al., 1998) and preserves cultural heritage (Nichols et al., 2005). The question of multilingual access and multilingual information retrieval is becoming increasingly relevant in digital library environment. It is often found that user communities like to have information in their local languages or scripts. So it is important to identify their needs and expectations about multilingual information processing in digital library environment (Wu, He & Luo, 2012).

Language issues in digital libraries are multifarious (Borgman, 1997). Thus managing multilingual information and provision of multilingual information services has become a big challenge for librarian in digital library environment. Several researchers (Dartois et al., 1997) reported that most research and development activities concentrated on different issues of multilingual environments. Crossing the language barrier is one problem and is concerned with the translation of resources. Several experts (Chung et al., 2004; Wang et al., 2006) present a solution to the problem of missing dictionary terms in a query translation. The other challenges are data management and representation of information (Klavans & Schauble, 1998); interoperability (Fox & Marchionini, 1998); development (Hutchinson et al., 2005); management and storage of contents and metadata (Karvounarakis & Kapidakis, 2000). To solve this problem, Maeda et al. (1998) developed a technology to enable viewing of multilingual documents in a Web browser. Another group of experts (Kramer, Nikolai & Habeck, 1997; McCulloch, Shiri & Nicholson, 2005; Yang, Wei

& Li, 2008) put emphasis on achieving semantic interoperability to solve this problem.

Another study (Budzise-Weaver, Chen & Mitchell, 2012) suggested strategies for building and sustaining multilingual information access for digital libraries. Peters & Picchi (1997) described mainly two issues (e.g. multiple language recognition, manipulation and display; multilingual or cross-language search and retrieval) that must be addressed in order to implement a multilingual interface for a Digital Library system. Borgman et al. (1996) reported problems towards designing digital libraries for distributed environments necessary for interoperability with other systems and services. In another paper he drew attention to the different multi-lingual issues such as medium, culture, and language and concluded with design challenges and technical matters involved in designing digital libraries (Borgman, 1997). Borbinhal & Machado (2005) described 'DEPTAL', as a collection-centric multilingual framework not only in the user and administration interfaces, but also in the handling of the contents. Another researcher (Baker, 1997) expressed concern over conceptual and organizational problem of maintaining metadata standard in multiple languages. Anderson (2003) provides an overview of the progress made in bringing historic scripts to the Unicode standard and also warns of the danger of failing to pursue such work actively.

Supporting searching and display in multiple languages is an increasingly important issue for all digital libraries accessible on the Internet. Searching for information in multi-media digital libraries is more complex than text-only searching. As Croft (1995) noted in an earlier D-Lib issue, general solutions to multi-media indexing are very difficult, and those that do exist tend to be of limited utility. Large & Moukdad (2000) gave an overview of multilingual information access issues in relation to the Web. Wellisch (1978) advocated the support of machine-readable catalogue formats for multilingual documents. He pointed out the problem of language experts for cataloguing a record in different language scripts and concluded that universal bibliographic control of documents cannot be achieved excluding multilingual documents.

2.1.9 Quality

Review is an essential part of the existing scientific and scholarly publishing process. The development and usability of any IDR system depends much on quality of resources. But still quality of contents is a low-prioritized aspect of digital libraries and digital repositories. Several experts (ALPSP, 2002; Bentum, 2001; Gonzalez & Porcel, 2007) reported that it (quality) presents another obstacle to faculty participation in IRs, as authors give importance only on peer view quality articles. The contents are the most important factor that has been cited by researchers to show

the success of a repository (Macha & de Jager, 2011). So, guaranteeing the quality of the contents of the repository is important to win the willingness of the authors and to achieve the intended outer institutional visibility (Gonzalez & Porcel, 2007). It is found that authors were overwhelmingly in favour of traditional peer review for guaranteed quality. It is also an important issue for most researchers as most of the readers want high quality, peer reviewed articles in their respective field (Swan & Brown, 2003). There are different grades of perceived quality. Scholars do not treat all peer reviewed reports as equally trustworthy; rather they rely upon a variety of processes and markers, which are dependent upon everything from the structure of the discipline itself to the social networks that the readers are embedded in (Kling & McKim, 1999). Jones (2007) reported that validation and verification of the data are an important factor. There are two levels of this task: the metadata about a particular scholarly work and the organizational and contextual information about the work. Several studies reported that all research-based work is not of high quality especially where pre-prints are concerned. This study recommended that it should be reviewed from the Dean or Head of the Department (<http://www.lib.unimelb.edu.au/eprints/collectionpolicy.htm>). Another study (Kling, Spector & McKim, 2002) argued that reputation of the department, in case of non-peer view articles, ensures the quality of the documents. Others expert (Wang & Wang, 2012) put emphasis on selection of persons with corresponding background knowledge to review the achievements submitted by researchers, which will identify the effectiveness, appraise the importance, and ensure the quality of IR. This view is supported by other researchers (Lee, Goh & Chua, 2010) and suggested that it can be carried out by the knowledge management expert with in the institution using a standardized checklist tool. Day (2003) suggested that as focus of an IR is on contents (peer-reviewed or not), the choice being left to those who develop their collection policies. Harnad (2003) recommended that work should be submitted to a refereed journal, and then the post print should be self-archived in a digital repository. Another study (Pinfield & James, 2003) proposed a mechanism for clear labeling of pre- and post-prints into two sections or in separate areas of the site. He concluded that departments can employ a kite mark, stamp system or metadata entry to show the level of quality of individual works in the IR. This will help users differentiate certified from non-certified content.

SPARC (2002a) recommended for differentiating between preprints and published peer-reviewed research. Other experts (Proberts & Jenkins, 2006) support this view and suggested to segregate pre- and post-prints into separate repositories. This study also put emphasis on quality of documentation as one of the evaluative criteria for any repository and this difficult issue should be made by individual institution and not mandated by international standards (Genoni, 2004). A few other experts (Robertson, 2005; Ochoa & Duval, 2009; Park, 2009) focused on quality of metadata because low-quality metadata compromise the effectiveness of services that repositories provide to their users. Other experts (Zschocke & Beniast, 2011) put emphasis on quality of educational metadata based on the ISO/IEC 19796-1 standard to describe the agricultural learning resources.

2.1.10 Software

The selection of software for any IDR system is crucial and this technical issue has been discussed by many researchers (Shoeb, 2010; Payne & Singh, 2010; Fay, 2010; Joint, 2006b; Crow, 2004; Falk, 2003). Several studies (Jones, Andrew & MacColl, 2006; Jones, 2007) discussed IR software systems and system feature and provided valuable advice on the topic of software selection. Pruet & Choi (2013) reported that libraries are now considering migration to an open source integrated library system. Barton & Waters (2004-2005) described in detail various technical aspects such as level of customization, file formats, metadata standards, system administration etc. for evaluating software for an IR system. It depends both on technical and non technical issues (Gibbons, 2004c; Powell, 2005) and on internal and external issues like usability, interoperability, support costs, and the ability to migrate materials over time, metadata standards (DeRidder, 2007). Lynch (2006) stated that factors such as repository contents, how it will be used, the features that are wanted, and the local technical environment need to be considered because even the 'best' software may not have every feature an institution wants. Cervone (2006) expressed concern over the issues regarding security and authentication, long-term cost and maintenance, vendor viability as well as training and documentation of the software. Another study (Singarella, 2005; Rankin, 2005) put emphasis on organizational goals and objectives and on organizational IT strategy (Powell, 2005) whereas Bevan (2007) concluded type of resources as other criteria for software selection. Beier & Velden (2004) pointed out that it should be compatible with existing products. Other researchers (Goh et al., 2006) developed an alternative set of criteria such as contents management, content acquisition, metadata, search, access control and security, report and inquiry, preservation, interoperability, user interface, standards compliance, automatic tools and support for evaluating open source software for repositories. A survey by Primary Research Group Inc. (2007) reported that selection of software varied markedly between different regions in the world such as the United States and Europe, and between developed and developing countries. Fortunately, a few brave institutions are sharing their methods for evaluating software solutions. One such institution is the University of Arizona (Han, 2004) whose evaluation strategy is more useful than the particular findings. JISC also has a very good site describing the evaluations made by its FAIR (Focus on Access to Institutional Resources) participants (http://www.jisc.ac.uk/index.cfm?name=fairsynthesis_repssoft). Another report (OARINZ Project, 2006) discussed and evaluated six repository systems and recommended that DSpace could be accommodated within the national network of New Zealand because DSpace scored well in the overall evaluation.

Technological issues have been discussed in several publications. There were two articles which compared IR software's (Budapest OAI Guide, 2004; Canadian Association of Research Libraries, n.d.). Open Society Institute (2004) provided a detailed and very valuable analysis of the existing repository software, including a

comparison between the two top performers, DSpace & EPrints. Its “*Feature & Functionality Table*” is an excellent guide to evaluating any software for managing digital repositories. Nixon (2003) shared practical experience using both EPrints and DSpace and compared between the two systems. Witten et al. (2005) described particularly two popular systems (Greenstone & DSpace) and compared their similarities and differences and also discussed possible opportunities for combining the advantages of the two. Another study (Prudlo, 2005) discussed three most widely known repository software packages and compared in terms of cost, underlying technology etc. Another experts (Marill & Luczak, 2012) evaluated repository software at the National Library of Medicine. Other experts (Smith et al., 2003; Tansley et al., 2003) restrict themselves to the design and functionality of the open-source DSpace IR whereas Rieh et al. (2007b) advocated that DSpace is the most prevalent system both in terms of pilot-testing and implementation. The other two survey report concluded that most CARL (Shearer, 2004) institutions and ARL-member libraries (Bailey et al., 2006a) are using DSpace. Another study (Deng & Reese, 2009) presented methods for customized mapping and metadata transfer from DSpace to Online Computer Library Center (OCLC). Another expert (Liu & Zhou, 2011) discussed several technical issues relating to implementing and using DigiTool, proprietary software by Ex Libris.

2.1.11 System management and Administrative parameters

Generally the questions may arise who will manage and the IDR? Or where will it be located? It is found that (OpenDOAR, 2012; ROAR, 2012) the very large majority of IDR sites studied in this research were run by the library (or information services) at the host institutions. There are a number of reasons cited as to why the library is the appropriate locus for the leadership of such projects (MIT, 2003; Branin, 2002; Joint, 2006c; Chang, 2003). Libraries are essential component of nation’s information infrastructure (Borgman, 2003a) and their staff plays a significant role in the development of institutional repositories (Bailey, 2005). "Linking people to resources" (O'Brien, 2005) has been the task of information specialists for many years. The ARL SPEC Kit survey results reveal that the library plays a critical role in initiating, planning, and implementing IRs (Bailey et al., 2006a). They further quoted by saying that “All respondents, implementers and planners alike, indicate that the library has been a driving force in the creation of or planning for an IR”. Pelizzari (2005) advocates the library as “the standard bearer for the IR.” Rockman (2005) quoted by saying that reference librarians are “natural partners to be involved with institutional repositories”. Quint (2002) urges librarians to assert themselves as the leaders in IR implementation. Another useful report (Rieh et al., 2007b) show that librarians take the lead in IR pilot testing and implementation, and funding for the IR almost always comes from the library. Another study (Phillips, Carr & Teal, 2005; John, 2005) identified the marketing role of librarian in promoting IR system.

A study by Pelizzari (2003) indicates over 70% of the respondents singled out the library as the structure to be given the mandate of managing an institutional archive. The other studies (De Beer, 2005; Kaur & Ping, 2009), the respondents in such studies were of the opinion that libraries should own and manage the IR. In most cases responsibility will likely fall to an information technology (IT) unit, to a library, or to a combination of these units. Gibbons (2004) advocates a partnership of librarians, instructional technologies training staff, and computer services staff for the IR effort. Ware (2004) asserts that IRs start with a partnership between the library, the institution's instructional technology unit, and a vice president's office (e.g., bursar or provost for academic studies). Allard, Mack & Feltner-Reichert (2005) identify librarians in these roles: learning how the IR works; leading the IR implementation effort; developing policy (especially with regard to defining collections); leading anything that pertains to metadata, reviewing submissions to the IR; and training contributors. Additional roles include evaluating IR systems, being an advocate for the IR, recruiting contents, and serving as advisory contributors on intellectual property issues (Chan, Kwok & Yip, 2005).

2.1.12 User Interface

Carefully consider several technical aspects of an IDR's user interface when selecting an IDR system. Gibbons (2004) identified several features of user interface and one of them is ease of use, no matter how sophisticated and elegant the backend of an IR system may be. The report also identified another feature of the interface that administrator should consider is the level of branding and customization available. It is practically useless without a usable interface on the front end. He concluded that the interface of an IR should reflect the culture and image of the institution. Hunter & Day (2005) discussed several practical issues of an IR's user interface and concluded that these issues are to be properly examined and reviewed before selecting an IR system. A few authors (Yee et al., 2003; Callahan & Koenemann, 2000) compared and evaluated different type of interfaces for browsing and searching digital image collections in electronic environment. Hornbaek & Frokjaer (2001) made a comparative study of three interfaces (linear interface, fisheye interface and overview+ detail interface) for reading electronic documents and Bekaert & Van de Sompel (2005) described two other interfaces based on two formal specifications (i.e., OAI-PMH and the NISO OpenURL Framework for Context-Sensitive Services (OpenURL Standard)). Designing multilingual user interface to meet the requirements of the local users is crucial and has been suggested by many experts (Del Gado & Nielse; 1996; Head, 1999; Rskin, 2000). Another group of authors (Phillips et al., 2005; Hunter & Day, 2005; Rieh et al., 2007b; Feijen et al., 2007) advocated for adopting own interfaces and customizing it rather than using the default user interface that comes with any software. Chen & Dumais (2000) reported the development of a user interface that organized web search results into hierarchical categories. Peters &

Picchi (1997) pointed out mainly two issues (multiple language recognition, manipulation and display; multilingual or cross-language search and retrieval) that need to be addressed in order to implement a multilingual interface for a Digital Library system.

2.1.13 Versions identification and management

The problem is multifaceted and growing and the difficulties associated with version identification and management existed long before the digital age. It is found that multiple versions and versioning issues have existed for centuries. Richardson (2005b) describes how IR aims to include post-prints. Quint (2006) supports this view and concludes that less evaluated contents may reach more users than expertly reviewed contents. Another study (Pinfield & James, 2003) recognises that e-prints regularly contain more information than published versions. Johnson (2001) reported that the official version of articles remains the peer-reviewed version. Academics often want the final version to be ingested whereas repository managers prefer to ingest everything to reflect the research process.

The software development sector is extremely important when considering version control and version management techniques. Another study (Allsop, Somerville & Shipsey, 2007) identified a number of techniques are promoted by the institution to assist in the version control of documents. These include using version numbers, naming conventions, read-only tags and version control tables. The process of software development necessitates the creation and management of many versions of source code, configuration files and documentation. The Version Identification Framework (VIF) provides practical advice and recommendations to authors and contents creators, repository managers and those involved with repository software on how to identify versions better (<http://www2.lse.ac.uk/library/vif/>). Puplett (2008) outlines the issues associated with versions in IRs, and discusses the solutions being developed by the Version Identification Framework (VIF) Project. He further discusses the number of potential versions created as part of a contemporary research project, and the potential number of relationships between iterations, variations, and manifestations. He suggests that versioning problems arise from reader confusion over the publication status of the contents they find in a repository. The problem of version identification can only be solved if the repository platforms that people use are able to identify version status and version relations of the objects that they store to the outside world (<http://www2.lse.ac.uk/library/vif/framework/SoftwareDevelopment/index.html>). Another study (Brace, 2008) explains why giving time to versioning within a repository is worthwhile and outlines the best practice to implement. The most significant issue for repository managers then, is how best to organize these multiple versions, and how best to describe them so they can be properly found. Decisions also need to be made over which version should be

ingested. Nagel (2006) suggests using subversion to help with personal information management of documents stored on different computers and storage media. Pitkow & Jones (1995) present a prototype web publishing environment, emphasising that version control should be supported, permitting multiple revision of documents, and graceful recovery from system and user errors.

2.1.14 Workflow management

Workflow design is core aspects of the operational responsibility of any IR system. Madsen & Oleen (2013) reported that as an IR matures it will face the challenge of how to design workflow. Morrow & Mower (2009) address the need for a workflow manager as a way to coordinate multiple persons in the deposit of numerous articles. Another survey report by IRs managers (Hanlon & Ramirez, 2011) indicates that a majority of IRs follow a mediated deposit process. The workflow problems relating to non-textual documents particularly those related to data curation have also been the focus of recent literature. Recent studies (Yoon & Tibbo, 2011; Witt, 2008) address the workflow challenges of “non-traditional” IR deposits (i.e. non-article/ETD contents). The other researchers (Boock & Kunda, 2009) compare the workflows for depositing electronic theses and dissertations in the Oregon State University.

Jones, Andrew & MacColl (2006) shared their own experience building the Edinburgh repository and discussed workflow diagrams including post-submission workflows, such as assigning items to categories, contents verification procedures, cataloguing steps and the verification and augmentation of metadata, short and long-term storage procedures etc. Aschembrenner & Kaiser (2005) described eleven workflows as identified by the DSEP process model and implemented by each of the reUSE demonstrators separately. Several authors (Green, Dolphin & Sherratt, 2007; Beier & Velden, 2004) explained the need for customization of workflow pattern for making a document publicly available. Jones (n.d.) described different methods used to customize workflow steps and concluded that customization process depends on different types of documents. Another study (Hulse, Cheverie & Dygert, 2007) advocated that workflow design should be based on a collection-by-collection basis and on lifecycles of the full range of institutional information resources (Campbell, Blinco & Mason, 2004). Nolan & Costanza (2006) shared practical experience in developing workflow and concluded that workflow (administrators, editors, reviewers, authors) for processing materials is based on the particular IR software.

2.2 Indian Scenario

This section examined open access movement (OAM) and open access repository (OAR) development from the perspective of India context. Several key issues from general to specific have been consulted on this aspect. Over the past seven to eight years, the implementation of OARs has been growing rapidly and the publications on OARs have flourished accordingly.

The open access initiatives and the development of OAM in India have been described by many researchers (Arunachalam, 2008; Gaur, Munshi & Murthy, 2004; Kataria, 2007b; Sreekumar, 2006; Sreekumar et al., 2007; Arunachalam, 2004a, 2004b, 2006; Hirwade & Rajyalakshmi, 2006; Doctor, 2005; Kirsop, 2007; Sahu & Parmar, 2006; Ramachandran, 2003; Tripathi & Tripathi, 2007; Fernandez, 2006; Swan, 2008; Satyanarayana & Babu, 2007; Urs, 2007; Ghosh, 2011, Sawant, 2009; Lal, 2008; Balaram, 2008; Kirsop & Chan, 2005; Sridhar, 2007; Roy, 2010). A few studies highlighted recent trends in the OAM and discussed the significance of those trends for information access in developing countries (Das, Sen & Dutta, 2005; Gobbur, 2007; Chan & Costa, 2005; Ghosh & Das, 2007; Sharma, 2007). Several other studies (Nazima & Devib, 2008; Mittal & Mahesh, 2008; Venkadesan, 2009; Gul, Shah & Baghwan, 2010) described growth and development of IR in our country. Another study (Roy, Biswas & Mukhopadhyay, 2012a) focuses on the OA initiatives and describes some of the current OA channels and the areas where India has made significant progress. A book published by UNESCO, authored by Anup Kumar Das (Das, 2008) gave a brief overview of IRs in India. Another study (Bhat, 2010) focused mainly in specific discipline like computer Science and IT (Information Technology) and specific area like universities and research institutes (Krishnamurthy & Kemparaju, 2011). Another expert (Sawant, 2011a) focused on planning, pilot testing, system implementation, exploratory activities conducted before implementation. In another paper she investigates the experience, contribution and opinions of users of respective (Sawant, 2012a). Another study finally makes recommendations for their successful implementation in academic institutions (Jain, 2011). A broad outline on the growth of OA archiving in developing countries focusing mainly on India and its benefits had been provided by Chan and his colleagues on Scidev.net (Chan, Kirsop & Arunachalam, 2005). One more article by Chan & Kirsop (2001) and a few articles by Professor Arunachalam were also important in this regard (Arunachalam, 2005, 2006). Specific Indian initiatives especially open archive initiatives were mentioned in this context. One of the important research papers was by Fernandez (2006) who evaluated the growth and development of online research repositories in India within the broader framework of OA. She conducted interviews with information professionals responsible for creation and maintenance of online research repositories in India. Swan (2008) focused on how OA can help to resolve the problems of maximizing the visibility, and thus the uptake and use, of Indian research outputs and how self archiving can provide a boost

to OA movement. Another study (Sahu, Goswami & Choudhury, 2013) looks at the use of the repository based on the repository log data. Another study (Arunachalam, 2008; Hirwade & Rajyalakshmi, 2006) discussed two ways of achieving OA vehicles viz. *open access journals* (OAJ) and *open access archives* (OAA) and focused on various fronts channels or where open access is making good progress and deliberated different issues of OA. In this context two government organizations (National Knowledge Commission, 2007; University Grants Commission, 2005) have been playing vital role in promoting OA contents of public funded research materials. Bangalore Declaration (2006) drafted a model OA policy to support full access of publicly-funded research outputs.

The needs of IR in Indian context have been identified by many professionals (Rajashekar, 2003; Arunachalam, 2004a, 2006, 2008; Prasad & Guha, 2005; Sreekumar et al., 2007; Patel, Vijayakumar & Murthy, 2005; Gaur, Munshi & Murthy, 2004; Sreekumar, 2006; Doctor, 2005; Kataria, 2007b; Swan, 2008; Fernandez, 2006; Deoghuria & Roy, 2007; Mittal & Mahesh, 2008; Suleta & Sangeeta, 2006; Varatharajan & Chandrashekhara, 2007; Chakravarty & Mahajan, 2006; Meitei & Devi, 2009). Several other experts (Vinayagamorthy, Ramesh Babu & Gopalakrishnan, 2006) highlights the present digital library initiatives in engineering educational institutions in Tamil Nadu. Another study (Mukherjee & Nazim, 2011) analyzes the present trend of institutional archives worldwide. Roy & Mukhopadhyay (2010) put emphasis solely on the development of learning object repositories (LORs) in India. Recent research (Babu et al., 2012) finds out the rationale for IR categories and various developmental challenges are underlined. Hashim & Jan (2011) examines five web based OARs for the purpose of identifying their strength and limitations, using pre-defined standard parameters. Another study (Roy, Biswas & Mukhopadhyay, 2011) provide an overview of Indian IDRs and compare in respect of contents, types, objects uploaded, software used etc. In other paper they give an overview of current state of OARs in Asian countries with special reference to SAARC countries (Roy, Biswas & Mukhopadhyay, 2012b). Another study (Roy, Biswas & Mukhopadhyay, 2013) compares OARs against different criteria, shows ranking of Indian IDRs in World's repositories and also describes several policy issues. A few researchers (Ghosh, 2009; Harnad & Swan, 2008) discussed the Indian contribution to OA and put emphasis on formulating and adopting a national OA self-archiving mandate for all of its research institutions and funders. The other researches (Swan, 2008; Singh & Pandita, 2005) advocated for mandatory policies that encourage authors to make their work OA and other experts (Sahu & Parmar, 2006) advocated the development of IR with government bodies. Many professional body and government organizations like INFLIBNET, UGC advocated for OA and supported mandating OA to all publicly funded research (Chand et al., 2004; Narang et al., 2005). Several other studies (Madhan, Rao & Awasthi, 2006; Vagiswari & Birdie, 2007; Swan, 2008; Srinivasan, Patil & Rajan, 2007) reported that IRs is essential for Indian research and advocated to populate IR in different ways. The other researchers (Khanna et al., 2013) describes a health

portal aiming at providing one-stop access to efficiently search, organize and share maternal child health information relevant from public health perspective in the country. Several other experts (Satyanarayana & Babu, 2007; Das, Dutta & Sen, 2007; Swain, 2010; Vijaykumar & Murthy, 2001) discussed e-theses initiatives throughout the country. Another expert (Ghosh, 2007a, 2007b, 2007c) broadly covers this OA movement and put emphasis on current development of e-theses initiatives in the country. In another paper she reported that the first ETD repository in India was started at the Indian Institute of Technology in Bombay in 1999, since then a number of small ETD repositories have been developed throughout India (Ghosh, 2009).

A number of problems come while designing OARs for an institution and have been discussed in the literature (Arunachalam, 2004a, 2006; Chan, Kirsop & Arunachalam, 2005; Tripathi & Tripathi, 2007; Kataria, 2007a; Deoghuria & Roy, 2007; Chand et al., 2004; Patel, Vijayakumar & Murthy, 2005; Senthil & Moorthy, 2006; Srinivasan, Patil & Rajan, 2007; Anuradha, 2005; Sreekumar et al., 2007; Nazim, 2009). Kumar (2012) reported that there are many technical, social, and expertise issues required for establishing IR such as selection of hardware, communication bandwidth, suitable software, international standards and documentation, including operational aspects like loading software, uploading data, set-up test server, manage process, maintenance and load material advocacy and preservation. Another study (Venkatesh, Nageswara Rao & Kalpavall, 2012) broadly covers digitization issues related to OSS including their merits and demerits. Doctor (2008a) determines the number of simultaneous users of an institutional knowledge repository in India context. Some other experts (Deoghuria & Roy, 2007; Hirwade & Rajyalakshmi, 2006; Satyanarayana & Babu, 2007; Srinivasan, Patil & Rajan, 2007; Singh & Pandita, 2005) pointed out that the development of IR depends much on active participation of key stakeholders of the institution and concluded that authors, librarians, researchers are not aware of the OA publishing. Sahu & Arya (2013) analyze the awareness of OA publishing among researchers and faculty members of the concerned institutions. Kataria (2007a) reported that organizational commitment is needed for the development of IR. A few researches (Deoghuria & Roy, 2007; Kataria, 2007b; Singh & Pandita, 2005) argued that stakeholders have also a role to populate IR. Fernandez (2006) described both top-down and bottom-up methods to promote repositories.

Several technical problems have been discussed in literature. Rajendran, Babu & Gopalakrishnan (2005) mentioned technical problems like font issues, lack of standard format, and reproduction of graphics. Rajashekar (2003) described several other problems like contents related standard and specifications, metadata standard, workflow pattern, OAI compliance software and preservation of digital objects. Several other authors (Satyanarayana & Babu, 2007; Singh & Pandita, 2005) put emphasis on quality of research materials and on lack of expertise (Kataria, 2007b; Hirwade & Rajyalakshmi, 2006; Satyanarayana & Babu, 2007) is another problem for developing IR. The lack of infrastructural facilities like hardware, obsolete technology, search engine and connectivity of high bandwidth have been identified as

another problems by many other researchers (Singh & Pandita, 2005; Sreekumar, 2006; Urs, 2007; Hirwade & Rajyalakshmi, 2006; Narang et al., 2005; Rajendran, Babu & Gopalakrishnan, 2005). The other experts (Das, Sen & Dutta, 2005) identified that web server does not work all time and the uniform resource locator (URL) has been changed in due course of time. This lack of accessibility has somewhat become a barrier to access, use and cite local research. IR has made the often limited dissemination and access of information extremely possible now in developing countries (Ghosh & Das, 2007).

Formulating policies (Table 4.2 of chapter 4) regarding different issues of IR is essential for smooth functioning of a repository. Several studies (Kataria, 2007b; Sreekumar et al., 2007; Madalli, 2005; Madhan, Rao & Awasthi, 2006; Srinivasan, Patil & Rajan, 2007; Satyanarayana & Babu, 2007; Urs, 2007) proved that formulating policies (contents development, contents recruitment, right management, preservation interoperability standard, multilinguality, workflow pattern etc.) are essential for developing IR. Swan (2008) advocated for mandatory policies that encourages authors to make their work OA. Sawant (2012b) investigates various issues concerning the management of IRs. Another paper (Das, Dutta & Sen, 2007) explores the policy frameworks, strategic dimensions and analyses SWOT (strengths, weaknesses, opportunities and threats) of existing ETD initiatives in India. Fernandez (2006) points out different issues like fund, submission policies. Ghosh (2007a) discussed the subject coverage, number of items, access policy, browse or search option, value added services etc.

Digital environment makes the copyright protection a difficult task. A number of issues and concerns are associated with the usage of digital information. A group of authors considered copy right or right management as most challenging issues of digital library environment and to be aware of this issue while depositing objects to the repository (Urs, 2007; Vagiswari & Birdie, 2007; Madhan, Rao & Awasthi, 2006; Madalli, 2005; Kataria, 2007b; Singh & Pandita, 2005; Doctor, 2008b). A few other studies (Satyanarayana & Babu, 2007; Rajendran, Babu & Gopalakrishnan, 2005; Narang et al., 2005; Srinivasan, Patil & Rajan, 2007; Rajashekar, 2003) reported that copy right and plagiarism issue are also responsible for the development of IR. Hombal & Prasad (2012) suggested that this issue may be controlled by imposing restriction on access using license and encryption methods. Another expert (Shashi Nath et al., 2008) discussed copyright issues in the context of populating IR. Moorthy & Karisiddappa (2005) discussed different issues and concerns of librarians in the face of the intellectual property laws like perpetual dependency; societal rights, pricing, access and ownership and highlights adverse impact of IPRs acts on knowledge society and open source initiatives. Yaranal & Ramesha (2012) explains the role of libraries and library professionals in managing the resources within the limitation of Intellectual Property Rights (IPR).

The organization and management of contents is crucial. Recruitment of contents is another major problem for the IDR development. This issue has been raised by several researchers (Madhan, Rao & Awasthi, 2006; Sreekumar et al., 2007). Other experts (Urs, 2007; Das, Sen & Dutta, 2005) focused on types of contents and on its quality (Satyanarayana & Babu, 2007; Singh & Pandita, 2005). University Grants Commission (2005) reported that most of the IRs achieves this (quality) through software having a submission buffer. Narang et al. (2005) advocated PDF format to build up e-theses collection. Rajashekar (2003) highlighted contents related standard and specifications.

Digital Preservation is not a new concern - it has been with us since the introduction of computers into our lives in the sixties. A few authors (Urs, 2007; Rajashekar, 2003; Katre, 2011; Chakravarty, 2010; Chowdhury, 2010) expressed concern over the preservation of contents in digital format. Another paper (Madalli, Barve & Amin, 2012) presents an analytical study along with observations regarding digital preservation support available in existing open-source digital library software (OSS-DL) based on test beds created for that purpose. Another expert (Barv, 2007) discussed several issues of digital preservation and recommended preferred formats for long term preservation of digital objects. Another report (University Grants Commission, 2005) concluded that the default formats accepted by most IR software are PDF, Postscript, ASCII, and HTML. Rajendra, Babu & Gopalakrishnan (2005) focused mainly on preserving print version of the theses and dissertations into electronic form. Patel, Vijayakumar & Murthy (2005) proposed IR as an economical way to save contents in digital form and format for long term purpose. Gaur & Tripathi (2012) highlights various problems and projects initiated. Another paper (Singh, 2012) discusses the initiatives taken by Indian government for digital preservation of cultural heritage resources and manuscripts. Another expert (Katre, 2012) made a comparison between the American and Indian digital preservation programmes based on the essential building blocks. Chandra & Gokhale (2012) describes OAIS reference model and identifies the tools and develops the processes to implement the preservation services and actions.

A few other authors (Narang et al., 2005; Satyanarayana & Babu, 2007) described IR as an information system model through which information flows everywhere with just the click of button. Another researcher (Rajashekar, 2003, 2004) proposed IRs as OA publishing model that organize OA resources and improve the quality of Indian research whereas Patel, Vijayakumar & Murthy (2005) proposed IR as an economical way to save digital contents. Another study (Vijayakumar, Murthy & Khan, 2006) proposed a prototype model for Indian universities to preserve electronic theses and dissertations.

Designing IR system with OSS has been discussed in several papers. A number of authors (Alexander & Gautam, 2004; Mittal & Mahesh, 2008; Das, Sen & Dutta, 2005; Jayakumar et al., 2007; Soundararajan et al., 2007; Jayakanth et al., 2008; Jain

& Shrivastava, 2008; Mishra et al., 2007; Anuradha, 2005; Narang et al., 2005; Madhan, Rao & Awasthi, 2006; Singh, Pandita, & Dash, 2007; Fernandez, 2006; Doctor, 2005; Lihitkar & Lihitkar, 2011; Sawant, 2011b; Chindalia, 2008; University Grants Commission, 2005; Barve & Dahibhate, 2012; Deka, 2006) highlighted the state of IR especially the use of OSS. Another study (Jayakanth, Minj & Dastidar, 2012) reported that many academic and R&D establishments have made it mandatory to set up IRs using OSS. The other researchers (Salve, Lihitkar & Lihitkar, 2012; Kamble, Raj & Sangeeta, 2012; Giri & Sengar, 2011) describe features of some of the popular software packages for developing their digital libraries. Kumar (2008) highlights problems of selection, installation and maintenance of OSS. A few studies considered that the selection of software is also vital issue and depends on different technical and non technical issues (Madalli, 2005) and Krishnamurthy (2007) put emphasis on several other issues like lower costs, greater accessibility, long-term preservation etc. Chand et al. (2004) identified the need of standard and protocol of OSS whereas Singh & Pandita (2005) advocated for OAI compliance IR software. Another group of authors (Madalli, 2005; Laxminarsaiah & Rajgoli, 2007b; Jose, 2007; Thakuria, 2008) advocated that DSpace is the most popular IR software in the open source domain and is widely used digital library software in India. Sawant (2012b) is in support by saying that 79 per cent of the institutions in India had used the DSpace. Alam & Pandey (2010) provides a mechanism for the development of a digital library using OSS like Greenstone. Sonkar et al. (2005) discusses in detail all the issues related to the development of digital library of newspaper clippings and implementation of Greenstone software in developing such collection. Biswas & Paul (2010) compared two popular IR software (Dspace & Greenstone). Another study (Sastry & Reddy, 2010) deals with the technical comparison between DSpace and Greenstone. Lihitkar (2011) highlights the comparison of features, function and usability of GSDL, Dspace and Ganesha. Another study (Patil, Kanamadi & Gopale, 2008) tries to make out the comparison, features, function and usability of OSS like DSpace, Greenstone and EPrints. The other experts (Singh, Witt & Salo, 2010) outlines the design of a comparative analysis of the four IR software packages like EPrints, DSpace, Fedora and Zentity in a comparative manner and concluded by saying that the output of this study will be highly useful for repository developers, repository managers, and especially those who are selecting a repository for the first time. Another study (Karmakar, Das & Thakuria, 2010) analyzed and compared two popular software Dspace and Eprints. Another expert (Lihitkar & Lihitkar, 2012) prepared a ranking of the software based on the assigned points for each criteria. The other experts (Mulla, Chandrashekhara & Talawar, 2010) put emphasis on usage and performance of various library software modules in engineering colleges of Karnataka.

Several other experts (Doctor, 2007; Jayakanth et al., 2008; Jobish et al., 2005; Krishnamurthy, 2005; Laxminarsaiah & Rajgoli, 2007a; Madalli, 2003; Sutradhar, 2006; Chand et al., 2004; Patel, Vijayakumar & Murthy, 2005; Senthil & Moorthy, 2006; Srinivasan, Patil & Rajan, 2007; Anuradha, 2005; Sreekumar et al., 2007;

Narang et al., 2005; Singh & Pandita, 2005; Doctor & Ramachandran, 2008; Vijayakumar, Murthy & Khan, 2006; Shewale, 2012; Jayakanth, Minj & Dastidar, 2012) have shared their practical experience in developing and maintaining IR at their own institution using OSS. Another study (Cherukodan, Santhosh Kumar & Humayoon Kabir, 2013) describe the design and development of a digital library at Cochin University of Science and Technology (CUSAT) using DSpace.

The other studies (Senthil & Moorthy, 2006; Kumar, 2005; Prasad, 2006) explain the need for customization of IR software and mention areas where customization is needed. Laxminarsaiah & Rajgoli (2007a) explained how to customize the metadata fields according to institutional requirements. Another study (Srinivasan, Patil & Rajan, 2007) focused on designing homepage customization of submission page.

Another technical issue is interoperability which ensures that outputs are discoverable. The need for developing interoperable OAR have been suggested by many researchers (Sreekumar et al., 2007; Narang et al., 2005; Rajashekar, 2003; Singh & Pandita, 2005; Chand et al., 2004; Awasthi & Jaiswal, 2008) in Indian context and creation and use of Open Archives (OA) is one approach to achieve some degree of interoperability (Alexander & Gautam, 2004). Prasad & Guha (2005) discuss the need of interoperability in digital library arena and explore the potential of the OAI-PMH protocol and illustrate its structural and functional models. The study also reported that most of the IDRs have adopted the existing metadata protocol OAI-PMH. Another researcher (Amin, 2003) proposed for OAI compliant repositories and described OAI-PMH framework and its technical architecture. Other experts (Hirwade & Hirwade, 2006; Hirwade & Bherwani, 2011) describe metadata, OAI-PMH and major metadata harvesting services in India. Another study (Singh, Pandita & Dash, 2008) explained how metadata is harvested (extracted) from Data Providers (Repositories) by Service Providers (Search Engines) using this model. Another research paper (Sarkar & Mukhopadhyay, 2010) presents a method of metadata harvesting from different OAI-PMH compliant repositories containing electronic theses and dissertations. This study has developed and described in details harvesting framework using PKP harvester. Another paper (Deshmukh, Bhavsar & Bhavsar, 2012) covers OSS available for federated search and gives some federated search applications of public domain.

It is essential to have a metadata schema for different types of object for easy access of information (Sreekumar et al., 2007; Prasad, 2006; Laxminarsaiah & Rajgoli, 2007a; Madalli, 2005; Rajashekar, 2003). Another expert (Hirwade, 2011) investigated the metadata standards available worldwide and analyzed of these standards. Narang et al. (2005) mentioned three metadata schemas MARC, Dunlin Core and ETD-MS. University Grants Commission (2005) reported that most of the digital repositories follow the qualified Dublin Core standards and unqualified Dublin Core standards and also suggested using other metadata schema to meet the needs of users to provide better access and management of different type of digital objects. Pal

(2010) discusses some emerging issues on metadata as a mechanism of resource discovery and its impact on precision of search results in a distributed network environment. Prasad (2006) made an attempt to accommodate additional metadata formats like IMS-LOM. Another researcher (Patra, 2008) described metadata requirements for setting up a digital repository in ceramics resources.

With the advent of Unicode and the development of information technology, the question of multilingual access and multilingual information retrieval is becoming increasingly relevant in digital library environment. Managing digital objects in Indic script is discussed in the literature (Maitra, 2002; Prasad, 2003; Mukhopadhyay & Azim, 2006). India is considered as a multi-religious, multi-cultural, multilingual country, which has massive amount of precious literature in many languages. India is a multilingual country with twenty-two constitutionally recognized Indian Languages and with many variations of dialects. There are 428 languages listed of which, 415 are living languages and 13 are extinct (Gordon, 2005). It is essential for any IR system to have Unicode standard multilingual environment for searching theses and dissertations (Karande, 2007; Patel & Madalli, 2007; Narang et al., 2005). Biswas (2005) highlights the development of Unicode standard, discusses some of the issues that must be addressed in order to implement a multilingual interface for a digital library system and the problems associated with character encoding of multilingual text in particular. The other paper (Madalli & Patel, 2009) aims to discuss the various issues involved in Indian languages computing, particularly Telugu, like creating, displaying, searching and retrieving digital contents. Another study (Mukhopadhyay & Azim, 2006; Mukhopadhyay, 2007; Das et al., 2005) developed Bengali script based digital library through the application of open standards and OSS. In another papers, Mukhopadhyay (2006a, 2006b) attempts to design Floss based software framework for public library based and Web-enabled multilingual community information service. Chandrakar (2002) described 'Unicode' standard UTF-32 that uses four bytes (32 bits) to encode all possible (millions) characters. In another paper he explains Unicode as a multilingual standard and the related technology available for localizing the Indian language materials is discussed (Chandrakar, 2004). Another study (Tripathi, 2004) focused on problems related to cross-lingual information retrieval due to the use of non-standard metadata schema by many of the libraries. He concluded that there is no significant development in Indian language machine translation. In another paper he described Saraswati, a cross-lingual Sanskrit Digital Library hosted at Banaras Hindu University (Tripathi, 2009). Karande (2007) proposed an implementation of multilingual search engine using a Universal Networking Language (UNL). Tripathi & Tripathi (2007) explained difficulties towards creating digital libraries in Indian languages. Another study (Vaidya & Jayakanth, 2006) explained the configuration changes that are needed for Eprints.org software to store multilingual contents and to create a multilingual user interface.

Designing user interface for any IR system is also a crucial issue (Singh & Pandita, 2005; Vaidya & Jayakanth, 2006). Jayakumar et al. (2007) explains a prototype IR

User Interface which was developed in-house at Indira Gandhi Centre for Atomic Research. Rajashekar (2003) described various workflow pattern of the IR system. Another expert (Sreekumar et al., 2007) is in support. University Grants Commission (2005) advocated for Web interface having provision for customization.

2.3 Findings of Literature Review: Gaps and Overlaps

Up to date most of the IDR studies trend to only focusing on the beautiful side of IDR, such as how many items are collected or what IDR can do in theory, and people do not want to touch the hard part – everyday work, the services, the usefulness of the service in practice and the quality of the IDR. Some think IDR has achieved more than they need and some believed it has not met the service level. This review looked at what studies have been done, what can be learned from the studies and what the gaps are.

A. Existing policy

A successful IDR can not be developed without giving serious consideration to its overall structure and design. This overall structure and governance can be initiated by developing IDR policies (as suggested in Table 4.2 of section 4.2.1 of chapter 4). Repository policies need to have clear explanations and examples but several policy issues are missing and have not been discussed in the literature which need to be developed in the line of global recommendations.

B. Advocacy and Promotion

The success of IDR system much depends on user's participation and voluntary involvement with the system. There should have publicity and branding policy of IDR resources. But studies lack focus on how IDR will increase in quantity, in order to become competitive with other providers. Another issue training and documentation (for end users, authors and administrators) has not been discussed in literature.

C. Contents

There are many decisions associated with the contents policy. There will be descriptive requirements, preservation issues, workflow pattern associated with different types of documents. There is no study as to how it will be structured. Consideration should be made of the types of checks and who is likely to be performing it. All these issues are not properly discussed in literature. No discussion about retrospective information or contents has been reported.

D. Legal Framework and Licensing Model

IDR don't have huge legal problems in their setting up but can face heavy issues in the development of a critical mass, consisting of journal papers written by researchers, faculty members which are commercially published. There are three parties involved in this system namely author, institution and publisher. It is not possible to have a single straightforward licensing policy as different publishers have different licenses. It would therefore, be desirable to have a customizable licensing system for items submitted to the repository. Studies do not have licensing policy for the legal issues in regard to uploading and accessing the documents. Even studies do not propose any licensing models for rights management of IDR System.

E. Access Control and Rights Management

IDR system must have mechanisms to restrict access to the information when OA is premature or otherwise not desirable. But a few studies have been conducted and further studies are required in this area.

F. Resource organization and management

For any IDR system, data standardization tools like standard lists, code lists or vocabulary control devices need to be followed but studies do not propose common standard, methods, tools and techniques in the organization of IDR resources. As a result services are not based on internationally agreed upon data standard.

G. Contents's Quality

Especially for the quality of the IDR contents, only a few studies have been done in this area. Validation and verification of the data are an important factor and there are two levels of this task: the metadata about a particular scholarly work and the organizational and contextual information about the work. These issues have been neglected in the literature. Studies do not clearly explain how quality is assured or who will measure the contents's quality. So, further studies are urgently needed in this area.

H. Metadata Schema

Studies do not recommend any domain specific metadata schema suitable for different types of objects. It would therefore, be desirable to have a flexible metadata schema that will be to able to combine the different requirements for each of the possible contents domains to produce a metadata set to be collected which is exactly appropriate. Another issue, authority control is a large issue in metadata submission. But this issue has not been discussed in literature.

I. Indexing services and standards

Another key issue is to develop common platforms to make IDR interoperable with other system in order to import and export of resources. Users aren't interested in browsing each IDR, there is a need to integrate resource discovery/search tool that can be built using OAI-PMH metadata structure. This issue has not been properly discussed in literature. Studies are urgently needed in this area.

J. Resource identification for perpetual access

Identifying and locating online contents is a key issue in repository systems to grant long-term access. IDRs need to assure the permanence of object names in the repository. It provides access to the contents on the same timescale and shows the relationship with other items is another. Each object should have a unique and persistent identifier such as +CNRI, handle, DOI, etc. But this problem still exists and it is barely treated in the literature, as a mere technical aspect. So studies are urgently needed in this area.

K. User Interface

There are hardly any studies have been done in this area. Any IDR system demands customizable, accessible, web service interfaces so that repository can participate in distributed application systems. Development of multilingual interface and mechanism to access multimedia learning objects has been ignored in literature. Studies are urgently needed in this area.

L. Multilinguality

This issue has been badly neglected in the literature. Crossing the language barrier is not the only challenge facing the multilingual digital libraries. Even studies do not recommend managing multilingual database. There is limited scope for multilingual search provision and access to multi format learning objects. Studies lack focus on multilingual data format that will support Universal Character Set (UCS). Additional problems and challenges are related to: data management and representation of information, interoperability (linking between systems) etc. Multilingual document indexing is also challenging because each language has different characteristics and rules. All these issues have not been discussed in the literature.

M. Model

There remains a lot of work to be done to determine best funding and business models however a few studies have been done in this area. Studies are urgently needed in this area.

N. Standard compliance

As the repository field is a new and developing one, some parts of the system have more agreed standards than others. Some standards, such as OAI-PMH, are part of the software and are well developed. The standards on metadata are still under development. All system is able to provide Dublin Core output, but this is not descriptive enough to be able to ensure complete interoperability and transfer of data between different systems. The system should be based on common standards in respect of software, data formats, import/export, access and network etc. but all these issues have not been properly discussed in the literature.

O. Preservation and Curation approaches

Studies do not discuss any specific plan for preservation along with backup strategy. Only a few studies discuss about file preservation. There is no study about in-house preservation system and these services are still under development. There are two technical issues: the first being to ensure that the physical item remains intact at the bitstream level and secondly that the digital object remains understandable has not been properly discussed. This challenge remains a long way from being solved. A coordinated strategy like OAIS (Open Archival Information Systems) reference model, the de facto standard for digital archive architecture is required to ensure long-term preservation of the IDR contents.

P. Software

Studies recommended using OSS for IDR system but there is no uniformity in using software for IDR system. Even software is not up to the global standard and demands customization to meet the local requirements. There should be options to allow the system to plug directly into local system. But studies do not recommend pluggable/modular software architecture that could be customized as per requirements.

Q. Workflow standard

This issue has not been examined broadly in literature. Studies do not recommend any standardized workflow pattern for different contents type. Generally, studies do not discuss workflow stages so that all verification and refinements can be done in a logical way.

R. Role of Librarian

It is not clear from the study as to who will manage IDRs system and what role and responsibilities librarian will perform in this distributed system.

S. Metadata Harvesting

Another technical issue like metadata harvesting from different OAI-PMH compliant repositories has been neglected in literature and no framework has so far been developed. There is no such mechanism of extracting metadata from multiple repositories.

In addition, not a single study recommends Indic script based subject access system (vide section 5.4 of chapter 5) in software framework for searching and indexing specific subject categories. Even, the existing study does not recommend use of social networking software (e.g. Blog, RSS etc.) in repository system for scholars.

In India, these problems are very much clear as there is a lack of published documents and almost all the documents are theoretical in nature and do not cover any policy in details. Only a few studies are institute specific but do not recommend any guidelines and best practices.

2.4 Need of Present Research

There are many studies, journal articles, papers and reports, survey on IDRs. Generally the works discuss mainly the pros and cons of IDRs. Only a few studies have been conducted so far that produces standards and strategies and suggests best practices. But all studies are theoretical in nature. There has been little research that discusses different issues and facets of IDRs, its technical architecture along with practical implementation for a specific organization. So there is an extensive gap in the literatures and several technical as well as non-technical issues have not been covered. Only a few technical papers have been published in India and almost all the studies are descriptive in nature. These documents do not provide any direction towards the building up IDR for a specific organization. There is no existing roadmap for how best to make progress. As it (IDR) is a flourishing area so indepth study is required for designing a policy document for a specific organization. This research work will help administrators in developing university specific repository policy based on global standards and procedures for managing disciplinary and institutional collections and will give a better sense of how to handle some operational issues when implementing a repository. In addition, there are many initiatives and recommendations at national and international levels by various organizations, funding agencies and learned societies that support observations made in previous section. The study will become a link between the research proposed and the studies already done in this area. Lastly, it will provide a handy guide to the topic and will give comprehensive knowledge to the professionals keeping them up to date with what is current in the field.

Chapter 3

Institutional Digital Repository: Evolution



“If we do not plant knowledge when young, it will give us no shade when we are old”.

Lord Chesterfield

Structure

- 3.0 Introduction
- 3.1 History
- 3.2 Timeline of Open Access Movement (OAM)
- 3.3 Definitions
- 3.4 Features
- 3.5 Benefits of Institutional Digital Repository (IDR)
- 3.6 Institutional Digital Repository (IDR) and Digital Library (DL)
- 3.7 Role of Librarians in Institutional Digital Repository (IDR)
- 3.8 Declarations and Statements – International
- 3.9 Declarations and Statements - National
- 3.10 Major Initiatives
- 3.11 Major Projects
- 3.12 Problems and Prospects of Indian Institutional Digital Repository (IDR)

3.0 Introduction

This chapter gives the reader sufficient understanding of the area under investigation, there is an introduction to the origins, history, features, benefits, national and international initiatives, major projects etc. This section also discusses chronological development of open access movement (OAM) along with problems and prospects of Indian institutional digital repositories (IDRs). Also discusses role of librarian in IDRs environment and shows relationship with digital library (DL). This is intended to highlight discussions as to the purpose and audiences of IDRs. By looking at some of the common definitions of institutional repositories (IRs) it is hoped that the focus of the research will be more clearly defined in an area that still contains uncertainties.

3.1 History

Repositories, in their broadest sense, have existed ever since humans began collecting and storing important information and artifacts for safekeeping and long-term use. The long and rich history of libraries, museums, and archives provides the foundation for any type of repository program, but two contemporary developments in particular have helped shape the nature of today's IDRs: the emerging knowledge management movement; and the maturing, but still rapidly advancing, technology of content or asset management in the digital information system. IDRs first appeared in 2002 as an institutional response to the increasing trend for scholars to post their research online, usually on their homepages (Johnson, 2002) but also in subject based repositories. Repositories are associated with a number of different scholarly initiatives and there is a large body of literature that describes open access repositories (OARs) and explores their role within scholarly communication and publishing. The development of OARs resulted in part from a need to address problems inherent in the present system of scholarly publishing. Few authors (Bergstrom & Bergstrom, 2004; Dewatripont et al., 2007; Tenopir, King & Association, 2000; McCabe, 2002; Falk, 2003) identified another reasons that rising cost of journals articles of commercial publishers led to the development of OARs. The other reasons behind the development of OARs are the problems addressed include the information explosion, delays in publishing and distribution inefficiencies, restrictive licenses, and copyright restrictions to authors. Jones, Andrew & MacColl (2006) have rightly identified the following elements that led to the development of IRs.

- E-thesis archives;
- Departmental e-print archives;
- Faculty practice of e-prints on personal web pages;
- Subject repositories;
- Need from institutions for preservation/presentation of research output;

- Open Access aims;
- Distributed document servers; and
- The 'Journals Crisis'.

Although the concept of open access (OA) has been around since the mid-1990s when the new, networked academic environment allowed researchers to communicate faster using the new digital communication channels. The knowledge management movement of the 1990's influenced the development of IDRs in a number of significant ways in addition to establishing the nomenclature (Branin, 2005). The major driving force behind the development of IDRs has been the dramatic shift in scholarly communication especially within the past five to ten years. The basic model for scholarly communication has remained unchanged for over three hundred years. There were problems associated with the present system of scholarly publishing (Harnad, 2006c; Odlyzko, 2006). The advent of the internet in the first half of the 1990s and digital technologies has enabled information to be accessed and disseminated far more easily than ever before. As a result, traditional publishing models are shifting and new models of scholarly communication are evolving. Different open access (OA) models are being developed and OAR has emerged as a new tool to provide access, manage costs, and manage an organization's scholarly output, especially at colleges and universities.

The history of institutional repositories (IRs) is relatively short, with the first discipline based repositories being implemented in the early '90s. Scientific journal was begun in 1665 to enable researchers sharing their work quickly and widely and to establish the priority of researchers investigating the same problem. Before OARs, the emerging technologies like File Transfer Protocol (FTP), Gopher, and the World Wide Web (WWW) were used to increase availability of scholarly material by lowering the barriers to distribution. The first published proposal for an institutionally focused repository was made by Okerson & O'Donnell (1995), writing for the Association of Research Libraries (ARL). Jones, Andrew & MacColl (2006) traced the first development of the idea of a repository of scholarly publications to the early 1990's. It was Paul Ginsparg, a physicist at Los Alamos National Laboratories in the US who in 1991, for the first time founded the Internet's first scientific preprint service, arXiv, allowing scientists to share ideas prior to publication. It (arXiv) provides OA to e-prints in Physics, Mathematics, Computer Science and Quantitative Biology. Other early repositories were also discipline based, such as:

- EconPapers (Economics working papers);
- CogPrints (Cognitive psychology); and
- PubMed Central (Biomedical and life sciences).

Three years later, cognitive science professor Steven Harnad posted on the Internet (Virginia Tech mailing list in 1994) what he called a "*subversive proposal*," asking researchers to immediately start self-archiving - depositing papers in a publicly accessible repository - is a landmark in the history of OA. He introduced *Psycoloquy*,

the first peer-reviewed scientific journal on the internet, which paved the way for free academic publishing on the web after 1993. Jones, Andrew & MacColl (2006) cite the creation of the Open Archives Initiative in 1999 as being a major factor in the rise of institution based repositories. This raises the question of whether an author should deposit their research in the institution or discipline repository. In addition, several Open Source Software (OSS) communities have formed to create successful digital repository software that is available for free. And now several digital repository software products are available on open source domain. In 2002, two seminal events occurred when the Massachusetts Institute of Technology (MIT) collaborated with Hewlett-Packard (HP) Corporation to launch an open-source institutional repository software entitled 'DSpace' and the SPARC (Scholarly Publishing and Academic Resources Coalition) published, "The Case for IRs: A SPARC Position Paper"(Crow, 2002a). The following are the list of key events in the history of OARs:

- 1991: Launch of the arXiv Physics repository.
- 1999: Sante Fe Convention which resulted in the agreement upon a framework for interoperable archives, now known as the Open Archives Initiative (OAI).
- 2001: Launch of Eprints by the University of Southampton.
- 2002: Launch of DSpace by Massachusetts Institute of Technology.
- 2002: Publication of Ryam Crow's SPARC Position paper entitled: The Case for Institutional Repositories: A SPARC Position Paper.

3.2 Timeline of Open Access Movement (OAM)

The Open Access Movement (OAM) is a social movement. The movement traces its history at least back to the 1960s, but became much more prominent in the 1990s with the advent of the digital communications, in particular the Internet. Before the advent of internet, File Transfer Protocol (FTP), Gopher, and the World Wide Web (WWW) were used to increase availability of scholarly material by lowering the barriers to distribution. With the spread of the Internet and the ability to copy and distribute electronic data at no cost, the arguments for open access gained new importance. It has since become the subject of much discussion among researchers, academics, librarians, university administrators, funding agencies, government officials, commercial publishers, and learned-society publishers. The major initiatives in the history of OAM have been highlighted chronologically. This is a list of landmark events in the history of open access (OA). The objective of this timeline is not to include all OA journals or all OA repositories or all recommendations made time to time. This study has included only the early pioneers that helped to prove the concepts. It also ignores individual books, articles, and speeches, no matter how important.

Year	Major Events
1980	The first online-only, free-access journals (eventually to be called "open access journals") began appearing in the late 1980s.
1990	Tim Berners-Lee wrote the first web client and server and published World Wide Web.
1991	The first free scientific online archive was arXiv.org, started in 1991, initially a preprint service for physicists, initiated by Paul Ginsparg.
1992	Entrez launched by the National Center for Biotechnology Information.
1992	First symposium on Scholarly Publishing on the Electronic Networks: Visions and Opportunities in Not-for-Profit Publishing, sponsored by the ARL and the Association of American University Press.
1993	CERN launched its preprint server.
1994	Self-archiving first proposed by Stevan Harnad.
1994	The Human Genome Project launched its open access website.
1994	The Social Science Research Network (SSRN) launched by Wayne Marr and Michael Jensen.
1995	D-Lib Magazine launched.
1996	Bermuda Principles issues by participants at the International Strategy Meeting on Human Genome Sequencing.
1996	Networked Digital Library of Theses and Dissertations (NDLTD) launched by Virginia Polytechnic Institute and State University.
1997	U.S. National Library of Medicine (NLM) made Medline.
1997	CogPrints launched by Stevan Harnad.
1998	The American Scientist Open Access Forum was launched (and first called the "September98 Forum").
1998	Scholarly Publishing and Academic Resources Coalition (SPARC) launched by Association of Research Libraries (ARL).
1999	The Open Archives Initiative (OAI) is launched in a meeting held in Santa Fe, USA to discuss mechanisms to encourage the development of open repository solutions and the integration and interoperability among the existing distributed and scattered e-print archives.
1999	Harold Varmus of the NIH proposed a journal called E-biomed.
1999	The Open Archives Initiative and its OAI-PMH protocol for metadata harvesting were launched in order to make online archives interoperable.

Year	Major Events
1999	BioMed Central announced plan to offer free online access to all its journals.
1999	Sante Fe Convention which resulted in the agreement upon a framework for interoperable archives, now known as the Open Archives Initiative (OAI).
2000	BioMed Central, a for-profit open access publisher, was launched by the then Current Science Group.
2000	BioMed central published its first free online article.
2000	DINI, the German Initiative for Networked Information (Deutsche Initiative für Netzwerkinformation) is a coalition formed by German Higher Education Infrastructure and Service Institutions.
2001	34,000 scholars around the world signed "An Open Letter to Scientific Publishers", calling for Public Library of Science, (www.plos.org).
2001	Southampton University released Eprints, its OAI-compliant software for eprint archiving.
2001	The Australian National University launched its E-Print Repository, the first OAI-Compliant institutional archive in Australia.
2001	The Public Library of Science (PLoS) officially launched <i>PLoS ONE</i> .
2002	Pubmed Central (www.pubmedcentral.nih.gov).
2002	The Open Society Institute launched the Budapest Open Access Initiative.
2002	MIT released DSpace, its OAI-compliant open-source software for archiving eprints and other academic content.
2002	OAIster launched by the University of Michigan Libraries Digital Library Production Services.
2002	Creative Commons launched by Lawrence Lessig.
2002	The Association of College and Research Libraries (ACRL) launched its scholarly communication initiative.
2002	Publication of Ryam Crow's SPARC Position paper entitled: The Case for Institutional Repositories: A SPARC Position Paper.
2002	The Public Library of Science (PLoS) received a \$9 million grant from the Moore Foundation for open-access publishing and announced its first two open access journals.
2002	The Howard Hughes Medical Institute committed itself to cover the publications costs when its researchers published in fee-based open access journals, apparently the first foundation or funding agency to do so.

Year	Major Events
2002	Project SHERPA (Securing a Hybrid Environment for Research Preservation and Access) and Project RoMEO (Rights METadata for Open archiving) launched by JISC-FAIR.
2003	The Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities was drafted and the World Summit on the Information Society included open access in its Declaration of Principles and Plan of Action.
2003	FEDORA (Flexible Extensible Digital Object and Repository Architecture) version 1.0 was launched by the University of Virginia and Cornell University.
2003	The Public Library of Science launched its first open access journal, <i>PLoS Biology</i> .
2003	The Directory of Open Access Journals (DOAJ) launched by Lund University with funding from the Open Society Institute (OSI) and SPARC.
2003	UN World Summit on the Information Society (WSIS) Declaration of Principles and Plan of Action, December 12, 2003.
2003	Wellcome Trust Position Statement on Open Access (Oct 2003).
2003	Declaration of Bethesda Statement on Open Access Publishing, June 20, 2003.
2003	Association of College & Research Libraries (ACRL) Principles and Strategies for the Reform of Scholarly Communication, August 28, 2003.
2003	The Medical Library Association issued its Statement on Open Access.
2004	The International Federation of Library Associations and Institutions (IFLA) released the IFLA Statement on Open Access to Scholarly Literature and Research Documentation, February 24, 2004.
2004	The Scottish Science Information Strategy Working Group released the Scottish Declaration of Open Access.
2004	A group of 48 non-profit publishers issued the Washington D.C. Principles for Free Access to Science.
2004	The Association of Learned and Professional Society Publishers (ALPSP) released the ALPSP Principles of Scholarship-Friendly Journal Publishing Practice.
2004	The Australian Group of Eight, the country's eight leading research universities, released a Statement on open access to scholarly information.
2004	Thirty-two Italian university rectors signed the Berlin Declaration on Open Access to Knowledge and released the Messina Declaration.

Year	Major Events
2004	Google announced the launch of Google Scholar.
2005	Participants at the 9 th World Congress on Health Information and Libraries released the Salvador Declaration on Open Access, September 23, 2005.
2005	University Grants Commission (UGC) drafted a policy framework entitled “UGC (Submission of Metadata and Full-text of Doctoral Theses in Electronic Format) Regulations, 2005”.
2005	The Royal Society for the Encouragement of Arts, Manufactures and Commerce published the Adelphi Charter on Creativity, Innovation and Intellectual Property, which articulated a positive vision of intellectual property and endorsed open access.
2005	The Wellcome Trust began implementing its new open access mandate for Wellcome-funded research.
2006	National Open Access Policy for Developing Countries known as Bangalore declaration, declared full Open Access to publicly-funded research publications.
2006	SHERPA launched JULIET, a database of the open access policies adopted by funding agencies.
2006	The Organization of Economic Cooperation and Development (OECD) issued Principles and Guidelines for Access to Research Data from public funding to implement its Declaration on Access to Research Data from Public Funding.
2006	The European Commission and nine European research institutions launched DRIVER, a large-scale, International knowledge infrastructure built on open access repositories.
2006	Participants in the iCommons iSummit for 2006 released the Rio Declaration on Open Access.
2006	The University of Nottingham (UK) and Lund University (Sweden) officially launched openDOAR.
2006	Federal Research Public Access Act was introduced in US Congress.
2006	CERN published a report outlining its project to convert all the toll-access journals in particle physics to open access.
2006	The Research Councils UK (RCUK) issued its long-awaited open access policy.
2007	MIT Open Courseware, an initiative of the Massachusetts Institute of Technology to put all of the educational materials from their undergraduate and graduate level courses online.
2007	India’s National Knowledge Commission (NKC) released a report recommending an open access mandate for publicly-funded research.

Year	Major Events
2007	Sage and Hindawi struck a deal to launch a new line of full OA journals, marking Sage's first foray into gold OA.
2007	SPARC and the DOAJ announced a project to develop standards for OA journals and provide help to publishers in meeting those standards.
2007	JISC and UKOLN launched SWORD 1.0 (Simple Web-service Offering Repository Deposit).
2007	The Directory of Open Access Journals launched a membership program.
2007	The Social Science Research Network (SSRN) officially launched the Humanities Research Network, a collection of OA repositories in different fields of the humanities.
2007	Lund University launched Journal Info, an online tool to help scholars evaluate journals where they might submit their work.
2007	JISC adopted an OA mandate for JISC-funded research in the April 2007 version of its grant guidelines.
2007	The UK Arts & Humanities Research Council (AHRC) announced an OA mandate for AHRC-funded research.
2007	The Canadian Institutes of Health Research (CIHR) announced an OA mandate for CIHR-funded research.
2007	The Howard Hughes Medical Institute (HHMI) announced its long-anticipated OA mandate for research publications by HHMI employees (the mandate took effect on 1 January 2008).
2008	The European Research Council (ERC) released the text of its OA mandate, which it adopted December 17, 2007.
2008	The US National Institutes of Health (NIH) released the text of its OA mandate.
2008	SPARC launched a new mailing list for discussing author rights.
2008	SPARC Europe and the Directory of Open Access Journals launched their Seal for Open Access journals program.
2008	The Canadian Library Association approved a Position Statement on Open Access for Canadian Libraries.
2009	The U.K Engineering & Physical Sciences Research Council (EPSRC) revealed that it had adopted an OA mandate
2009	Peter Suber launched the OA tracking project (beta).
2009	Senators John Cornyn and Joe Lieberman re-introduced the Federal Research Public Access Act (FRPAA) in the US Senate. FRPAA would mandate OA at a wide range of US federal agencies.
2010	Alhambra Declaration. From the participants in the meeting, Open Access to Science Information: Policies for the development of OA in Southern Europe

Year	Major Events
2010	Cape Town Declaration in a meeting sponsored by CODATA International and the South African National Research Foundation
2011	Ghent Declaration. From four participants at the meeting to launch OpenAIRE
2011	The Washington Declaration on Intellectual Property and the Public Interest
2011	The Open Government Declaration from The Open Government Partnership
2012	The Denton Declaration: An Open Access Manifesto from the University of North Texas
2012	The Paris OER (Open Educational Resources) Declaration from the UNESCO World OER Congress
2012	The Croatia Declaration on Open Access from the Faculty of Electrical Engineering and Computing (FER) of the University of Zagreb
2013	The Tasman Declaration from the inaugural New Zealand Australia Open Research Conference

Table 3.1: Timeline of Open Access Movement

3.3 Definitions

In a general sense, an Institutional Repository (IR) can mean many things. A library, an archive, or even a warehouse that stores an organization's records falls under the broad definition of an IR. There is no common shared vision of what a digital repository is while its formal definition has changed over the last 25 years. The seventh edition of the Concise Oxford Dictionary, 1982 defines repository as a 'receptacle; place where things are stored or may be found, museum, warehouse, store, shop; burial place'. The term "institutional repository" may have dissimilar meaning to different people (Allard, Mack & Feltner-Reichert, 2005). As the concept is rather new, there are diverse opinions on its meaning (Bailey, 2005). Early definitions emphasize a mission to collect and preserve unique institutionally produced material. The term repository as it refers to a storage unit is in itself well-known (Fowler, Fowler & Thompson, 1995). In February, 2008, new terms were introduced, namely the concept of a 'digital repository' (McHugh et al., 2007) and 'trusted digital repositories (Harmsen, 2008). The basic concept is the same. Although all repositories share common attributes, but there are several forms of digital repository apart from institutional, including learning object repositories and research data repositories (Zuccala et al., 2007). That's why suitable definitions are needed to adequately distinguish between them for the purposes of function, administration and investigation. There are several key definitions of institutional digital repositories

(IDRs) that are widely quoted has been given by several open access advocates. Foster & Gibbons (2005) defines it as “an electronic system that captures, preserves, and provides access to the digital work products of a community”. Many formal definitions for an IDR can be found in the literature, perhaps, the most relevant being the ones given by SPARC (Crow, 2002a), Clifford A. Lynch (Lynch, 2003) and Mark Ware (Ware, 2004). In a 2002 SPARC position paper, Crow (2002a) defined an institutional repository (IR) as

“a digital archive of the intellectual product created by the faculty, research staff, and students of an institution and made accessible to end users both within and outside of the institution, with few if any barriers to access”.

He further extends the definition by referring to IRs as ‘... digital collections capturing and preserving the intellectual output of a single or multi-university community’. Crow’s definition also focuses on a service rather than a physical storage area. This definition is one of the earliest in the literature, and so is considered influential. Another advocate Lynch (2003) defines it as follow.

“[A] Set of services that a university offers to the members of its community for the management and dissemination of digital materials created by the institution and its community members. It is most essentially an organizational commitment to the stewardship of these digital materials, including long term preservation where appropriate, as well as organizational and access or distribution”.

It is clear from above definitions that Crow emphasizes on the collection of material whereas Lynch on the services provided in support of access to materials. Bailey et al. (2006a) defines an IR as means of collecting and providing access to diverse, locally produced digital materials. Donovan & Watson (2008) describe IR as a means of collecting the intellectual digital outputs of an organization. Another study by Jones (2006) attempts to synthesize the key points of definitions of IR from the literature as being:

- Institutionally defined;
- Scholarly;
- Cumulative and perpetual (i.e. continuously open and available);
- Open and interoperable (Open Access and Open Archives Initiative compliant);
- Capturing and preserving events of campus life; and
- Searchable within constraints.

Ware (2004) adds OAI-compliance in his IR definition: An IR is defined to be a Web-based database (repository) of scholarly material which is institutionally defined (as opposed to a subject-based repository); cumulative and perpetual (a collection of record); open and interoperable (e.g. using OAI-compliant software); and thus collects, stores and disseminates (is part of the process of scholarly communication). Another expert (Rowland et al., 2004) is in support. In addition, most would include

long-term preservation of digital materials as a key function of IRs. Crow (2002b) is in support by characterizing an IR as open, interoperable, cumulative, and perpetual, contributes to the process of scholarly communication in collecting, storing and disseminating the scholarly content.

Repositories can take many forms, and all sorts of websites and databases could be considered to be repositories. So it may be concluded that IDRs are an electronic system of digital collections that captures, organize, preserve, and make accessible the intellectual output of a single institution or a group of institutions.

3.4 Features

To define any kind of feature set for any system it is necessary to think about the scope and objectives of the system and how it will be used in its target environment. Current thinking, IDR as a part of digital library system, suggests that the institutional repository should be able to meet the following criteria (Genoni, 2004; Johnson, 2002; Lynch, 2003).

- institutionally defined;
- scholarly;
- cumulative and perpetual;
- open and interoperable;
- digitally capture and preserve many events of campus life; and
- search with constraints.

SPARC Position Paper reported that an IR has main four characteristics mentioned above (SPARC, 2002a). Another expert (Gibbons, 2004a) identified five core features of IRs: “digital content; community driven and focused; institutionally supported; durable and permanent; and accessible content. A few other authors have identified the following characteristics of IDRs.

- A wide range of materials can be included (Prosser, 2003b); and
- The collection houses material in a digital format (Costanza, 2005).

On the basis of the above study, it may be concluded that generally an IDR should have the following common features mentioned below:

1. scholarly in nature;
2. contents is in digital form in a wide variety of types (text, audio, video, images, data sets);
3. community focus, where the community determines what is included in the repository;
4. institutional support, requiring collaboration across an organization;
5. durable (persistent URL for material), permanent contents that can be migrated over time; and
6. access to contents by a broad audience.

3.5 Benefits of Institutional Digital Repository (IDR)

There are many potential benefits an IDR can achieve and these exist at various levels, from the individual researcher to the university as a whole (Olivier, 2007). Several experts discussed and explained the advantages of IDR in several angles. Kircz (2005) believes an IR can become “a research tool in itself” and, for the institution, becomes “the central metabolic organ for knowledge”. The PALS study (Ware, 2004) indicated the following main IR uses: scholarly communication, education, e-publishing, collection management, long term preservation, institutional prestige, knowledge management and research assessment exercises. Another report (Gibbons, 2004b) identifies IR benefits as: stewardship, efficiencies, a scholarly showcase, wider distribution and a response to the crises in scholarly communication. In the ARL Spec Kit Survey (Bailey et al., 2006a), the top three reasons ARL libraries give for implementing IRs are institution-centered—to increase global visibility of, to preserve, and to provide free access to the institution’s scholarship. They, in the same survey, identified three main benefits of having an IR: visibility and increased dissemination of the institution’s scholarship; free, open, timely access to scholarship; and preservation and stewardship of digital content. Another study (Heijne, 2005) reported that repositories can hold the intellectual record of the universities output, increase access to institutional research and thus its impact and provide input to national research outputs, as has been evidenced by the DARE initiatives in the Netherlands. Yeates (2003) also listed the benefits of IRs, such as: extending the range of knowledge sharing, existing investment in information and content management systems can be leveraged; and more flexible ways of scholarly communication are available. A few other researchers (Dill & Palmer, 2005; Gibbons, 2004c; Lynch, 2003; Prosser, 2003b; Crow, 2002a, 2002b; Swan, 2005) advocated that IRs are ideal for long-term preservation and can provide an interoperable preservation system for working documents or for research data. Banks (2006) argues that OARs represent an exciting possibility for both the preservation and retrieval of grey literature. To summarize, the potential uses of an IR are: scholarly communication; management and storage of learning materials, electronic publications and research collections; preservation of digital research work; building university profile by showcasing academic research work; providing an institutional leadership role for the library; research assessment; encouraging open access; and housing digitized collections (Barton & Waters, 2004). This study discussed and explained the benefits of IDR mainly in four areas mentioned below:

- Benefits to Institutions;
- Benefits to Users;
- Benefits to Researchers; and
- Benefits to the Society.

A. Benefits to Institutions

Several compelling reasons exist for why an organization would want to establish an IDR. If an IDR is right for an organization, the reasons likely include some of the following ones. For teaching institutions, the advantages of a repository for teaching and learning purposes can be highlighted – a place for the creation and stewardship of teaching materials and for their access by learners.

A.1 Raising the institutional profile

Institutional Repositories have potentially significant benefits for institutions if they are integrated holistically into university frameworks. The most prominent reason is the increase in visibility and impact of research output (Jones, Andrew & MacColl, 2006; Crow, 2002b; Gibbons, 2004b). “Institutional repositories, by capturing, preserving, and disseminating a university’s collective intellectual capital, serve as meaningful indicators of an institutions’ academic quality” (Crow, 2002a). If this increased visibility is associated with high quality, the results may be tangible benefits to the institution in the form of continued or new public and private funding, and increased applications from potential students and staff (Prosser, 2004). Bjork (2004) states that IRs can be devoted to find alternative marketing channels for universities. The other experts (Prosser, 2003a; Johnson, 2002) stress the benefits of gaining broad access, dissemination and federated research for each institution, better impact for research, visibility for institution, advertisement, funding, measurement of impact for each institution through centralization of content. The other benefits for the academic institutions are as the following (Crow, 2002a, 2002b; Chan, 2004): a new scholarly publishing paradigm that wrests control from publishers and puts it back in the hands of the academy; increased visibility, prestige, and public value; maximal access to the results of publicly funded research; increased numbers and diversity of scholarly materials that are collected and preserved.

A.2 Total intellectual output

At the other end of the publishing scale, Hall suggests that IRs may become the new university presses. In this scenario, local peer review and quality control will evolve into full scale publishing ventures (Hall, 2003).

A.3 Teaching and learning

Teaching and learning can be supported by links to IR content from virtual learning environments (VLEs) and the library catalogue (Day, 2003). Lecture notes, handouts, presentations and images are all suitable content. Course materials can be shared, ‘re-purposed’ and re-used. Crow (2002a) refers to the benefits of saving “non-ephemeral

faculty-produced teaching material'. Lynch (2003) is in support and argued for setting up an IR for improving teaching and learning.

A.4 Supporting institutional record keeping

It facilitates records management and reporting and supports the institutions obligations regarding health and safety record-keeping, freedom of information, and accountability (Heery & Anderson, 2005). Other experts (Swan et al., 2005b) suggest that the potential compilation of an 'institutional CV' is "one of the most persuasive points for an institution considering setting up an archive". Another study (Prosser, 2003a) is in support by saying that it can act as a CV.

A.5 Cost savings

Librarians hope that, in the longer term, widespread adoption of OA publishing will allow savings to be made from institutions' subscriptions to academic journals. However, this is unlikely to occur until a 'critical mass' of content has been achieved (Pinfield, 2002). This outcome, of course, denies the complementarity of OA and traditional publishing models. Shearer (2003) states that IR can be useful for helping developing an effective and economic scholarly communication in the developing countries. Johnson (2002) states that OARs are a practical, cost effective, and strategic means for institutions to build partnerships with their faculty to advance scholarly communication. It reduces the cost of accessing and obtaining scientific information (Dill & Palmer, 2005).

B. Benefits to Users

There are many benefits for users/or authors who utilize an open archival system such as an institutional digital repository. Here are some common ones mentioned below:

B.1 Dissemination and impact

Academic authors produce research papers to share knowledge. They do this for their careers and for personal satisfaction. Success is achieved by disseminating work widely and quickly, with the hope of achieving the maximum citation impact (Hubbard, 2003; Pinfield, 2004; Harnad, 2006c, 2006d; Pickton, 2005). Studies have shown that "the usage of open access research is 330% greater than for toll-access research" (Lawrence, 2001; Harnad, 2003), and the more an article is downloaded, the more it is eventually cited (Antelman, 2004). Conversely, the more restrictive the access arrangements, the less an article will be read (Kurtz, 2004). A primary benefit of OA archiving is increased citation to and impact of your research. As Peter Suber in an interview says, OA is the microphone of your research (Poynder & Suber, 2007)

and this view is supported by other experts (Kurtz et al., 2005; Odlyzko, 2002). Harnad & Brody (2004) explained that OA can only increase both usage and impact. Jacso (2006) believes that OARs are beneficial for all the stakeholders, including publishers, editors and authors as they can substantially increase their impact and the impact factor for the source journals. Chan (2004) opines that OARs facilitate more timely and OA to research and scholarship and maximize the potential research impact of archived publications.

B.2 IDR contents

Cervone (2004), compared with traditional print publishing, reported that the IR offers the ability to store and provide access to a much wider variety of material. Researchers produce articles and reports, but also “original art, grant proposals, maps, radio/TV interviews, motion pictures, music scores, photographs, consulting (technical) reports, technical drawings, and poster session displays”. All of these, once converted to digital format, might be deposited in the IR. Moreover, supplementary material such as supporting evidence and data, interim reports and draft versions of papers may also be stored.

B.3 Feedback and commentary

The content of a repository need not have been through a peer review process. In some disciplines it is conventional for researchers to make preprints available to their own research community in order to receive comments or assert priority (Hubbard, 2003). Repositories that serve subjects with these cultures have been found to be particularly successful at attracting content.

B.4 Added value services

IR systems can produce hit counts on papers, personalized publication lists and citation analyses (Hubbard, 2003; Pinfield, 2002). These tools can create useful post-publication quality indicators (Pinfield, 2004). For the individual, monitoring download activity provides a measure of the impact of their research (Swan et al., 2005b).

B.5 Personal and promotional uses

IR can also work as a tool for publication of research work (Foster & Gibbons, 2005). On these pages we can list our publications and showcase our work – with direct links to the full-text of our research papers in the institutional repository. It can act as an advertisement for funding sources and industrial sponsors (Prosser, 2003a).

B.6 Networked information

The IR offers advantages to both ‘academics-as-authors’ and ‘academics-as-readers’ (Gadd et al., 2003c). The same system that facilitates the dissemination of academics’ own work also enables them to gain access to the work of others. Internal and external cross-searching is invaluable to multidisciplinary subjects such as the social sciences (Crow, 2002a). Repositories that are OAI-PMH compliant are effectively networked together to form a worldwide, openly accessible resource. Lynch suggests there may be benefits in ‘federating’ IRs to enable cross repository search, backup, preservation and disaster recovery capabilities (Lynch, 2003). He envisages ‘consortial’ or ‘cluster’ IRs in which multiple universities will share the cost and workload of IR maintenance. Crow suggests that multiple mirrored and distributed repositories, varying in location and format, are the best practice model for digital preservation (Crow, 2002b). Swan et al. (2005b) suggest that a ‘harvesting’ system would be an optimal way of providing access to such a distributed network. Peters lists other advantages of the consortial approach, namely, increased economies of scale, more comprehensive subject coverage, potential for improved authority control, the avoidance of redundancy (of both expertise and computing capacity) and savings in harvesting effort (Peters, 2002).

C. Benefits to Researchers

IDRs are beneficial to all researchers and entire research community. IDRs are more flexible archives in terms of use, offering greater security and long terms access to researcher’s own material. It maximizes research impact and access and research items get a permanent URL (Uniform Resource Locator) which

- maximise the accessibility ...
- maximise the availability ...
- enable the discoverability ...
- enable increased functionality ...
- enable longterm storage and curation ...
- enable other potential benefits ...

D. Benefits to the Society

As scholarship is shared, society at large is benefited. It

- provide access to the world’s research;
- provide local access to global research;
- ensures long-term preservation of institutes’ academic output; and
- can accommodate increased volume of research output (no page limits, can accept large data-sets, ‘null-results’, etc.).

To summarize, Prosser (2003a) encapsulates ‘By working together we have the power and ability to change this process (scientific publishing) to the advantage of our authors and researchers, and society as a whole’. The following table (3.1) summarizes the benefits of IDRs among different stakeholders.

Communities and Stakeholders	Benefits
Institutions	Increases visibility and prestige; acts as an advertisement to funding sources, potential new faculty, raising the institutional profile, total intellectual output, teaching and learning, supporting institutional record keeping, cost savings, unique place of resources.
Users	Dissemination and impact, IR content, feedback and commentary, added value services, personal and promotional uses, networked information.
Researchers	Provide a central archive of their work, increase the dissemination and impact of their research, more control over their work.
Society	Provide access to the world’s research; ensures long-term preservation of institutes’ academic output.

Table 3.2: Benefits of IDRs among Different Stakeholders

So there are a number of justifications for creating IDR. The argument for a repository is, of course, quite a new one. On the basis of the discussion it can be summarized that IDRs are essential for enhancement of knowledge at the academic institutions and society as a whole.

3.6 Institutional Digital Repository (IDR) and Digital Library (DL)

With the expression ‘IDR’ goes along the idea of creating a ‘DL’. The distinction between institutional or disciplinary is due to the scope of a repository or a digital library whether it serves a single institution or collects materials belonging to a specific discipline. The studies (Jones, 2006; Poynder, 2006) suggest that IRs is not yet well established and the only distinction given is the institutional focus of the service or collection. Several other experts (Borgman, 2003b; Amos, 2006; Lagoze, 1995) reported that IRs is firmly based within the theoretical framework of digital libraries. Another study (Jones, Andrew & MacColl, 2006) is in support and in the light of Ranganathan's (1936) five laws of library science, they indicated that digital libraries can only be considered as within the traditional scope of libraries based on the condition of selection, i.e. materials are included in a collection subject to a

collection development policy. This opinion is in common with IR practitioners who see lack of clear collection policies as a barrier to further institutional repository development (Salo, 2008). Another study (Heery & Anderson, 2005) distinguished digital repositories from digital libraries in defining a digital repository as having the following characteristics:

- Content is deposited in a repository, whether by the content creator, owner or third party;
- The repository architecture manages content as well as metadata;
- The repository offers a minimum set of basic services e.g. put, get, search, access control; and
- The repository must be sustainable and trusted, well-supported and well-managed.

Another researcher (Jones, 2007) in his book clearly stated that major differences between these types of repository can be identified as the expectation of who will be populating the system and the scope and purpose of the collection. In digital libraries, information is likely to be added by specialist cataloguers with a professional interest whereas in IRs information is added by the author. He concluded that in digital libraries, collections are based on a topic or material type regardless of the location of the author but in IRs the collection is based on the location and or employer of the author. The other differences may be as follow:

- IDRs are organized around a particular Institutional community while DLs may be built around any number of organizing principles (often topic, subject, or discipline);
- IDRs are dependent upon the voluntary contribution of materials by scholars for the content in their collection while DLs are the product of a deliberate collection development policy;
- IDRs are mainly repositories and therefore may only offer limited user services while DLs are typically include an important service aspect (reference and research assistance, interpretive content or special resources); and
- In DLs any document which is the subject area of the institution may be uploaded whether it is belong to institution or not, but in case of IDRs only production of particular institute created by its members only may be uploaded.

So it is quite clear from the study that the IDRs and DLs differ each other by the way of description of the contents. The structure and organization is different too.

3.7 Role of Librarians in Institutional Digital Repository (IDR)

Librarians have always been entrusted with keeping and preserving the human record. Until recently, they have been seen as passive gatekeepers of information. They were considered as mediator of information but now are considered as knowledge generator and act as intermediaries between faculty and the development team. But the evidence of considered literature seems to stress the importance of librarians as key stakeholders: their traditional roles are extended, but there are also new commitments. However, their roles and training has not been so deeply investigated

until the last few years. Open access movement (OAM) and the development of institutional repositories (IRs) had posed several questions about the role and skills required by librarian. Libraries and their staff play a significant role in the development of IRs. “Linking people to resources” (O'Brien, 2005) has been the task of information specialists for many years. The role and core competencies of library professionals have been the subject of recent debate (Chan, 2006; Mullins & Linehan, 2005; Sargeant & Harrison, 2004). Rockman (2005) claims that reference librarians are “natural partners to be involved with institutional repositories” because of “their service orientation, subject experience as knowledge managers, and communication skills”. Several studies (Horwood et al., 2004; Jenkins, Breakstore & Hixson, 2005; John, 2005; Krishnamurthy, 2007) discussed the role of librarians in the development and promotion of IDRs. The following are the broad headings under which roles of librarians in IDRs environment have been discussed.

A. Encouraging authors to contribute contents with self archiving

Academicians are not familiar with IDRs system and find it difficult to submit article to the IDRs system. So academicians need librarians' help in this submission process. Several studies show that faculty members do not carry out self-submission. Swan & Brown (2005) found that the majority of authors were unconscious about the benefits of publishing their works in IR and are facing problem in taking on contents from graduate students, faculties and researchers (McDowell, 2007). Genoni (2004) stated that it is the responsibility of library staff to encourage members of the university to deposit material into the IR. He further advocated that submitting outputs of researchers on behalf of those who cannot self archive their materials is another solution to make them contribute to IDRs. Bailey (2005) concentrates on reference librarian roles in advocacy of IR materials. Another study (Bell, Foster & Gibbons, 2005) is in support and lists the practical steps useful to improve faculty participation in repository projects and to increase access to grey literature for all scholars and addresses a current problem regarding faculty contributions. Another expert (Drake, 2004) remarks that librarians are taking leadership roles in planning and building these repositories, fulfilling their roles as experts in collecting, describing, preserving, and providing stewardship for documents and digital information.

B. Promotion and marketing

Promotion and marketing of IDRs has become an established role of librarians (Allard, Mack & Feltner-Reichert, 2005). Marketing role is indeed the most recognized and agreed role for librarians, since it has a strong weight in case studies and papers (Buehler & Boateng, 2005; Phillips, Carr & Teal, 2005; Graham, Skaggs & Stevens, 2005). It is essential that librarians be familiar with the library repository to efficiently promote IRs. IRs concept may need more explanation, marketing and a multiplicity of concerns by librarians (Jenkins, Breakstone & Hixson, 2005).

C. Collection development and management

Librarians have a critical role in the collection management and development process. In managing collection, they perform a new role as collection administrator (Branin, Groen & Thorin, 2000; Lee, 2000; Pettijohn & Neville, 2003; Gibbons, 2004; Bailey, 2005). Literature also indicates that librarians are facing problems in collection management because the acquisition of collections is in the hands of faculties (Allard, Mack & Feltner-Reichert, 2005). Genoni (2004) also writes about the need for librarians to approach the task of content development in repositories by applying some of the procedures and skills associated with collection management. Because they can add authors or give permission to authors to self archive materials in the repository (Crow, 2002a; Harnad, 2001; Lynch, 2003).

D. Policy and budget

One of the most vital and often unexplored issues of IDRs is creating policy. Several decisions related to IDRs policy need to be taken before setting up repository. Bailey (2005) concentrates on role of librarian in the creation of policies and procedures about metadata, workflow, interfaces etc. This issue has also been discussed by other experts (Allard, Mack & Feltner-Reichert, 2005). Genoni (2004) discusses copyright and journal embargo policies along with file format issue. Another study (Chan, Kwok & Yip, 2005) reports that librarians help in creating IR policies and procedures for content management and contact publishers to investigate their policies and license agreements where authors refuse or fail to do it. They encourage faculty members in self submission process and make them aware about copyright issues and new technologies (Swan & Brown, 2005; McDowell, 2007; Genoni, 2004). Other experts (Gibbons, 2004; Wheatley, 2004) identified another important issue e.g. digital preservation and discussed their role in this particular context. They know better than anyone else, how to reduce the budgets and increase the cost of resources in running an IR (Chang, 2003; Phillips, Carr & Teal, 2005).

E. Providing training for search technique

Librarians are playing a crucial role in providing training to IDRs users (Allard, Mack & Feltner-Reichert, 2005; Bailey, 2005). They help users and authors to fill content into the IRs and guide them to extract from IRs. They should teach users that how they can recruit search techniques to use the available resources (Jenkins, Breakstone & Hixson, 2005). It is essential that librarians be involved in planning, implementation and operation of IR. In the absence of a core training programme for repository managers, repository development work is now falling into the hands of reference librarians (Chan, Kwok & Yip, 2005).

F. Developing standard metadata along with catalogue and Indexing system

Selection of metadata for IDRs system is important and librarians have a role in metadata selection (Bailey, 2005; Allard, Mack & Feltner-Reichert, 2005). Abrizah (2010) pointed out creation of guidelines concerning metadata as a task for librarian. Another study (Beall, 2005; Genoni, 2004) suggests that librarians should prepare a comprehensive system for cataloging and indexing the materials in order to provide IR metadata, such as local controlled vocabularies, to be negotiated with users. Gibbons (2004) is in support by saying that they should design metadata standards for authors. Another researcher (Genoni, 2004) outlines that review the metadata of content to maintain the quality of record. They add content in databases and catalogues that will increase the chance of researcher to find their relevant resources (Jenkins, Breakstone & Hixson, 2005). Beside, providing good search tools and cataloguing the repository materials will make IR contents more accessible.

G. Review submission for quality of contents

Quality of contents is another issue in repository development and this verification is done by the librarian at the different stages of submissions (Genoni, 2004; Allard, Mack & Feltner-Reichert, 2005). Lynch (2003) believes that the IR environment would be orderly if librarians can be answerable to this role because some IRs does not want to take author's assistance due to the need of quality checks.

H. Understanding of software and making awareness about new technologies

Literature indicates that selection of software for creating IDRs is crucial factor and librarians are the efficient person and have enough knowledge about this issue. Allard, Mack & Feltner-Reichert (2005) identifies several roles such as understanding software in order to design repositories in their libraries. Another study (Abrizah, 2010) is in support by saying that they provide training authors use of IR software. Another group of authors (Swan & Brown, 2005; McDowell, 2007; Genoni, 2004) indicate that they make authors aware about new technologies. There is no doubt to entrust this responsibility to librarians since history shows librarians have navigated the way in using and designing new technologies. Librarians are expert in adjustment with new changes and professional in development of the environment (Branin, Groen & Thorin, 2000).

So it seems logical that librarians would be strong advocates for establishing IDRs as they are the main designers, promoters and maintainers of IDRs. IDRs development has resulted in new responsibilities for academic librarians in planning, management, and technical development. To meet these demands, some established positions have been modified; additional technical lines, such as research programmers, have been added; and new types of positions have been created, such as: repository coordinator;

intellectual property specialist; data research librarian. They revise or expand standards and procedures and introduce new informational products and services for the users. They teach users how they can recruit search techniques to use the available resources. They help in building search interface for searching and accessing the materials in repositories. They create controlled vocabularies and thesauri; create preservation methods and techniques; and select, organize, review and filter the repositories e-content quality. So whatever may be environment/or platform their roles will remain the same as it was before in traditional library.

3.8 Declarations and Statements - International

The following section briefly overviews some of the key IR initiatives and projects worldwide arranged alphabetically. This overview does not intend to be exhaustive as globally there are currently many repository development projects. The aim is to provide an overview of some of the major initiatives, in particular those that have led the way and served as an example for other repository projects. In order to popularize the OA initiatives amongst the various stakeholders, some important declarations and statements have already been made during the past decade where the world's leading research institutions representing from developed and developing countries have agreed upon the OA mandate. The following declarations have demonstrated that the OAM has continued gaining momentum from library and information associations, research funding agencies, scholarly societies, and institutions of higher education.

A. Association of College & Research Libraries (ACRL)

ACRL, a division of the American Library Association, is a professional association of academic librarians and other interested individuals. It is dedicated to enhancing the ability of academic library and information professionals to serve the information needs of the higher education community and to improve learning, teaching, and research. ARL released its Principles and Strategies for the Reform of Scholarly Communication, endorsing open access (<http://www.ala.org/ala/mgrps/divs/acrl/about/whatisacrl/index.cfm>).

B. Association of Learned and Professional Society Publishers (ALPSP)

The ALPSP is the international trade association for not-for-profit publishers. It was formed in 1972. Today it is the only international trade association representing all types of nonprofit publishers, and is the largest trade association for scholarly and professional publishers. Its mission is to play an active part in shaping the future of academic and professional communication, promoting 'Scholarship-Friendly Publishing'. It serves, represents and strengthens the community of not-for-profit

publishers, demonstrating their essential role in the future of international academic and professional communication (http://en.wikipedia.org/wiki/Association_for_Learned_and_Professional_Society_Publishers).

C. Australian Research Council (ARC)

The ARC encourages researchers deposit their research in a repository within a six-month (6) period. Any research outputs that have been or will be deposited in appropriate repositories should be identified in the final report (http://www.arc.gov.au/pdf/DP08_FundingRules.pdf).

D. Australian Research Information Infrastructure Committee (ARIIC)

The ARIIC was established by The Hon Brendan Nelson MP, Minister for Education, Science and Training, to advise on the development of research information infrastructure for Australia. It's role is to advise the Government on the information infrastructure requirements of the Australian higher education sector and their intersection with the wider information and technical infrastructures used by the scholarly and research community. In order to produce high quality research, researchers must have access to research data, including large specialised data sets, and to the products of research, including scholarly publications (<http://www.dest.gov.au/NR/rdonlyres/1765E617-B428-4A84-8678-4357ED448EB1/5571/ARIIC1.pdf>).

E. Berlin Declaration

The Declaration came out of a three-day conference hosted by the Max Planck Society in Berlin in October 2003, where Germany, France and Switzerland signed what has become known as the "Berlin Declaration". 'The Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities' is a clear commitment to encouraging European researchers to change their publishing habits. The Berlin Declaration promotes the Internet as a functional instrument for a global scientific knowledge base and human reflection and to specify measures which research policy makers, research institutions, funding agencies, libraries, archives and museums need to consider." The Berlin Declaration emphasis on promotion of the new OA paradigm to gain the most benefit for science and society and also intend to make progress by encouraging researchers to publish their work according to the principles of the OA paradigm" (<http://oa.mpg.de/lang/en-uk/berlin-prozess/berliner-erklarung/>).

F. Bethesda Statement

The following statements of principle were drafted during a one-day meeting held on April 11, 2003 at the headquarters of the Howard Hughes Medical Institute in Chevy Chase, Maryland. It resulted in the "Bethesda Statement on Open Access Publishing",

which extended the definition of open access. It is the statements of principle about the steps for all parties involved to take to promote the transition to open access publishing. The Statement also introduces the requirement that open access documents be deposited in digital repositories in "well-established" organizations, as opposed to author home pages or digital archives whose long-term prospects are in doubt. These repositories will engage in "long-term archiving." In other words, they will digitally preserve open access documents (<http://www.earlham.edu/~peters/fos/bethesda.htm>).

G. Bermuda Principles

One of the first international statements on open access is the Bermuda Principles, published in 1996. The Bermuda Principles, developed by scientists involved in the International Human Genome Sequencing Consortium and their funding agencies, establish a basis for the rapid and free sharing among scientists of pre-published data on gene sequences. Their intent was to make entire genome sequences freely available in the public domain for research and development, in order to maximize benefits to society (<http://eprints.qut.edu.au/9671/1/9671.pdf>).

H. Budapest Open Access Initiative (BOAI)

In December 1-2, 2001, the Open Society Institute (OSI) organized a meeting in Budapest; the outcome of this meeting was the Budapest Open Access Initiative (BOAI). It is a worldwide coordinated movement to make full-text online access to all peer-reviewed research free for all. The purpose of the meeting was to accelerate progress in the international effort to make research articles in all academic fields freely available on the internet. It is at once a statement of principle, a statement of strategy, and a statement of commitment. The BOAI recommends two complementary strategies e.g. *Self-Archiving* and *Open-access Journals* (<http://www.soros.org/openaccess>). The initiative states that by Open Access they mean: "free availability on the public internet, permitting any users to read, download, copy, distribute, print, search, or link to the full texts of these articles, crawl them for indexing, pass them as data to software, or use them for any other lawful purpose, without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself" (<http://www.soros.org/openaccess/read.shtml>).

I. European Commission (EC)

In January 2006, the European Commission (EC) recommended that research funding agencies have a central role in determining researchers' publishing practices. Following the lead of the National Institute of Health (NIH) and other institutions, they should promote and support the archiving of publications in open repositories (http://ec.europa.eu/research/science-society/pdf/scientific-publication-study_en.pdf).

J. European Research Consortium for Informatics and Mathematics (ERCIM)

ERCIM - the European Research Consortium for Informatics and Mathematics - aims to foster collaborative work within the European research community and to increase co-operation with European industry. Leading research institutes from nineteen European countries are members of ERCIM (<http://www.ercim.eu/>). ERCIM provides advice and strategic information to the EC and to member states, coordinates much IS/IT research across Europe and runs R&D projects. ERCIM also acts as the European host of W3C, the World Wide Web consortium (<http://www.stfc.ac.uk/Sites%20and%20Facilities/3599.aspx>).

K. Ghent Declaration

The Ghent Declaration, an initiative of the reviewers of the OpenAIRE project, encourages a move from open access to research and scholarship towards the creation and use of open data, open source software and open educational resources. The declaration was written in the context of OpenAIRE's launch event and first year's review held on December 2-3, 2011, in Ghent, Belgium. The partners of OpenAIRE welcome the declaration and will undertake all efforts to support full deposit of articles according to the OA mandate (<http://www.openaire.eu/en/component/content/article/76-highlights/223-seizing-the-opportunity-for-open-access-to-european-research-ghent-declaration-published?format=pdf>).

L. Information Access Alliance (IAA)

The Information Access Alliance (IAA) was formed in 2003 by leading US national library organizations to address problems in the scholarly and legal publishing markets, which are characterized by insupportably high prices, accelerating industry consolidation, and anti-competitive practices by some large publishers. IAA supports a competitive, vibrant, and diverse academic publishing marketplace in which the interests of research, academic institutions, and the public are well served (<http://www.informationaccess.org/about/index.shtml>).

M. International Consortium for the Advancement of Academic Publication (ICAAP)

The ICAAP was launched as a research and development organization within Athabasca University, devoted to the advancement of electronic scholarly communication. Its mission includes technological support, production, publication, and enhancement of scholarly journals and educational resources, with the goals of greater accessibility, recognition and communication within the academic

community. The ICAAP web site offers a searchable database of journals (<http://www.icaap.org/about.php>).

N. International Federation of Library Associations and Institutions (IFLA)

IFLA recognizes that achieving affordable, global access to scholarly information and research documentation will require a great deal of commitment and a variety of strategies. IFLA strongly supports the Open Access movement and welcomes the launch of many OA compliant publications. IFLA is committed to ensuring the widest possible access to information for all peoples in accordance with the principles expressed in the Glasgow Declaration on Libraries, Information Services and Intellectual Freedom. IFLA recommends that publicly funded research data should be openly available through internet free of cost (<http://archive.ifla.org/V/cdoc/open-access04.html>).

O. International Open Source Network (IOSN)

IOSN is an initiative of APDIP (Asia-Pacific Development Information Programme) and supported by the International Development Research Centre (IDRC) of Canada. It promotes the adoption of free/open source software, open standards, and open content for sustainable human development in the Asia-Pacific region. IOSN, initiated in 2003, is a network with a small secretariat based at the UNDP Regional Centre in Bangkok and three centers of excellence – IOSN ASEAN+3, IOSN PIC (Pacific Island Countries), and IOSN South Asia, based in Manila, Suva and Chennai respectively (<http://www.apdip.net/projects/2003/iosn>).

P. National Institutes of Health (NIH)

In the United States, the National Institutes of Health (NIH), the world's largest funder of medical research, strongly encourages their funded researchers to submit their articles to PubMed Central as soon as possible after publication. The NIH urges all the researchers it funds to make their research articles publicly available in the NIH digital repository. The NIH Public Access Policy ensures that the public has access to the published results of NIH funded research (<http://grants.nih.gov/grants/guide/notice-files/NOT-OD-05-022.html>).

Q. Organisation for Economic Co-operation and Development (OECD)

The OECD provides a forum in which governments can work together to share experiences and seek solutions to common problems. The said organization work with governments to understand what drives economic, social and environmental change. The mission is to promote policies that will improve the economic and social well-being of people around the world. It measures productivity and global flows of

trade and investment. It also analyses and compare data to predict future trends (www.oecd.org/documents/0,2340,en_2649_34487_25998799_1_1_1_1,00.html).

R. Public Library of Science (PLOS)

The Public Library of Science (PLOS) is a nonprofit organization of scientists and physicians committed to making the world's scientific and medical literature a public resource, founded in 2000. The goals are providing unlimited access to the full text of latest scientific research to scientists, librarians, publishers physician, patient, or student anywhere in the world (<http://www.plos.org/about/index.php>).

S. Salvador Declaration

Participants in the Ninth World Congress on Health Information and Libraries and Seventh Regional Congress of Information in Health Sciences (ICML9/CRICS7), gathered in Salvador, Bahia, Brazil, from September 19 to 23, 2005 and declared the statement known as “Salvador Declaration” (<http://www.icml9.org/public/documents/pdf/en/Dcl-Salvador-Commitment-en.pdf>). The main objectives were

- to promote broad and equitable access to national and international sources of information and knowledge, strengthening the necessary infrastructure through movements such as "open access";
- to establish solutions that respond to the needs of broad and equitable access to goods and services of information and intellectual property rights; and
- to strengthen health systems and services to enable the access and application of knowledge in an efficient, effective and socially just manner.

T. Scholarly Publishing and Academic Resources Coalition (SPARC)

SPARC, is an international alliance of academic and research libraries working to correct imbalances in the scholarly publishing system. It was developed by the Association of Research Libraries (ARLs). SPARC serves as a catalyst for action, helping to create systems that expand information dissemination and use in a networked digital environment while responding to the needs of academe. Its pragmatic focus is to stimulate the emergence of new scholarly communication models that expand the dissemination of scholarly research and reduce financial pressures on libraries (<http://www.arl.org/sparc/about/index.shtml>).

U. Scottish Declaration

The project work overlapped with the signing of the Scottish Declaration on Open Access by the University of Stirling, and this emphasized the importance to the University of providing access to the research that the University produces. The Declaration states that: ‘We believe that the interests of Scotland will be best served

by the rapid adoption of open access to scientific and research literature.’ The declaration supports the general principles of open access and encourages researchers to deposit copies of their work including PhD theses in an IR (<http://scur1.ac.uk/WG/OATS/declaration.htm>).

V. UK Research Councils

The UK Research Councils (RCUK), the public agencies funding research in all disciplines, issued its “Position Statement on Access to Research Outputs” in June, 2005. The draft policy calls for mandating the RCUK grantees to deposit the results of their research, published articles and conference presentations, in open repositories at the earliest opportunity. Research Councils UK has undertaken extensive consultation with key stakeholders and aims to be able to publish an updated position statement in early 2006 (http://www.sqw.co.uk/file_download/171).

W. Washington D.C. Principles

Founded in March 16, 2004, a statement by 48 non-profit publishers (including many scientific professional societies) committing to "providing free access and wide dissemination of published research findings." Many scientific societies who were also publishers of scholarly journals became alarmed over the OA movement, these societies created the “D. C Principles,” which support some degree of free access, but not to the extent of immediate access as required by the Bethesda and Berlin Statements (<http://www.dcprinciples.org/statement.htm>).

X. Wellcome Trust Position Statement

It is a strong endorsement of OA from a major UK funding agency and the World's largest private funder of medical research, October, 2003. The mission of the Wellcome Trust is to foster and promote research with the aim of improving human and animal health. The main output of this research is new ideas and knowledge, which the Trust expects its researchers to publish in quality, peer-reviewed journals. It supports unrestricted access to the published output of research as a fundamental part of its charitable mission and a public benefit to be encouraged wherever possible (<http://www.wellcome.ac.uk/About-us/Policy/Policy-and-position-statements/WTD002762.htm>).

Y. World Summit on the Information Society (WSIS)

United Nations had organized a World Summit for Information Society (WSIS) in two phases. The first phase was organized in December 2003 at Geneva and the second and final phase was organized in November 2005 at Tunis. The Summit stressed the importance of access to information and knowledge for global welfare. The objective of the World Summit on the Information Society (WSIS) was to

formulate a common vision and understanding of the global information society. It is expected to adopt a Declaration of Principles and an Action Plan to facilitate the effective growth of the Information Society and to help bridge the digital divide (<http://www.wougnet.org/WSIS/wsiscg.html>).

3.9 Declarations and Statements - National

Many influential groups have made statements and formal resolutions in response to changes and challenges in the realm of scholarly communication (SC) and publishing. These have included prominent universities, professional associations, public and private funding agencies. Most such statements include the posting of scholarly works in institutional or discipline-based repositories as a positive response to the SC crisis. More over, funding agencies are beginning to recommend or to mandate self-archiving of work paid for by their research funds. Many initiatives have already been taken by the different Ministries of the Government of India and research institutes for universal access to the outcome of the scholarly literature produced out of the public funding. Ministry of Human Resource Development (MHRD) has set up the 'Indian National Digital Library in Engineering Sciences and Technology (INDEST) Consortium' (Arunachalam, 2004a). In this direction the different organizations has made marvelous recommendations on OA initiatives. Thanks to Professor Subbiah Arunachalam, Professor N. Balakrishnan, and the late T.B. Rajashekar, who created one of India's first OA repositories at the Indian Institute of Science (IISc), Bangalore. Professor Subbiah Arunachalam, organised a workshop on 'Open Access and Institutional Repositories' under the aegis of the M. S. Swaminathan Research Foundation, Chennai, in May 2004. As per ROARMAP (ROARMAP, 2012) database, nine Indian institutes have registered their IR in this database and have declared their open access policy. The following are the major Indian initiatives described below:

A. Bharathidasan University

As of November 2006, Bharathidasan University has made it mandatory for all faculty members publishing in refereed journals to send their papers to the University Informatics Centre (matram AT bd.u.ac.in) for deposit in the university's IR. The university believes that the repository will increase the citation of its publications and will boost interdisciplinary research collaboration among the faculty (<http://www.eprints.org/openaccess/policysignup/fullinfo.php?inst=Bharathidasan%20University%20>). The university stands second only to the National Institute of Technology, Rourkela, in implementing OA in India and it has taken the lead among general universities.

B. Council of Scientific and Industrial Research (CSIR)

CSIR is in favour of OA to public funded research and duly approved the implementation of the following recommendations of the "Group for Open Access to Science Publications (GOASP) of CSIR" (<http://roarmap.eprints.org/114/>):

- *All research papers published from all CSIR laboratories be made open access either by depositing the full-text and the metadata of each paper in an institutional repository or by publishing the papers in an open access journal in the first place;*
- *All the CSIR published journals to be made open access; and*
- *Each laboratory sets up its own interoperable institutional open access repository.*

C. Mahatma Gandhi University

In India the first university to take initiative for making its research results OA is Mahatma Gandhi University. The launching of the Mahatma Gandhi University (MGU) Open Access Digital Archive of PhD Theses (www.mgutheses.org) in 2008 by Former President of India Dr. A. P. J. Abdul Kalam the live presence of the archive in the Web for the last two years is a success story among Indian universities (<http://roarmap.eprints.org/308/>). It is accessible from anywhere at any time through the URL (<http://www.mgutheses.org>) since its launching in 2008.

D. Madurai Kamaraj University

The university advocated that result of the public fund research should be made publicly available and accessible online free of cost. The university has adopted Open Access policy (i.e. Support Immediate-Deposit & Optional-Access" (IDOA) policy) model recommends (<http://openaccess.eprints.org/index.php?/archives/71-guid.html>):

- *immediately upon acceptance for publication*
- *deposit in the university's Institutional Repository*
- *the author's final accepted draft (not the publisher's proprietary PDF)*
- *both its full-text and its bibliographic metadata (author, date, title, journal, etc.)*

Most of the institutions are therefore designing this type of policy. Most new institutional and funder policies are of this type.

E. National Institute of Oceanography

National Institute of Oceanography (NIO) mandates its researchers to provide the post-reviewed manuscripts for archiving at its institutional repository "Digital Repository Service" (DRS). After the publication of the items, the pre-print or post-prints are to be archived based on the publishers' policy. The purpose of DRS is to give immediate, permanent and free access to its published research. The institute

believes in enhancement of the visibility to the published literature thereby attracting citations to the articles and maximizes research impact (<http://roarmap.eprints.org/325/>).

F. National Knowledge Commission (NKC)

The NKC's (National Knowledge Commission, 2007) Working Group on "Open Access and Open Educational Resources and Working Group on Libraries" have strongly recommended for open access and advocated that, on policy level, all research articles published by Indian authors receiving any government or public funding must be made available under Open Access and should be archived in the standard OA format on his/her website. The Commission has therefore made few recommendations to ensure sustained attention to development of libraries. Further, as a national academic OA portal is developed, these same research articles should be made available through this portal (http://knowledgecommission.gov.in/downloads/documents/wg_open_course.pdf).

G. National Institute of Technology, Rourkela

All research papers by faculty and students, M. Tech (Research) and Ph. D. thesis is to be self-archived in Dspace@nitr or it should be submitted to the librarian for archiving, so that others interested may benefit by referring to these documents. The Administration may use this archive for assessment of faculty performance when needed (<http://www.eprints.org/openaccess/policysignup/fullinfo.php?inst=National%20Institute%20of%20Technology%20Rourkela>).

H. National Open Access Policy for Developing Countries

A special session on OA was held at the 93rd Indian Science Congress in January 2006, which is known as Bangalore declaration. The workshop was conveyed by the Indian Institute of Science, the Indian Academy of Sciences and M.S. Swaminathan Research Foundation. It was supported by Open Society Institute (OSI). In 2006, participants in Bangalore conference which was held in November 2-3, 2006, drafted a model National Open Access Policy for Developing Countries (http://www.ncsi.iisc.ernet.in/OAworkshop2006/pdfs/National_OAPolicyDCs.pdf). The main objective was to bring together policy makers and research scientists from major developing countries to agree a path forward towards adopting full Open Access to publicly-funded research publications. It came up with several recommendations for the 'Optimal National Open Access Policy' (Sahu & Parmar, 2006).

I. University Grants Commission (UGC)

Another major recommendation in support of open access made by University Grants Commission (UGC, 2005) and drafted a policy framework entitled “UGC (Submission of Metadata and Full-text of Doctoral Theses in Electronic Format) Regulations, 2005”, to strengthen national capability of producing electronic theses and dissertations and to maintain university-level and national level databases of theses and dissertations. This Regulation proposed two sets of planned actions, such as:

- Creation of Indian national Theses Databases; and
- Submission of PhD Theses in Electronic Form.

It has already developed a policy document on building University level IDR (http://www.ugc.ac.in/new_initiatives/etd_hb.pdf) in India. It has also recommended that all the universities should set up theses repository to facilitate e-submission, archiving, maintenance and access to these repository at the university level.

In addition, MHRD has also advised all INDEST members to set up IR using OSS. In this area an initiative has been taken with the establishment of Open Source Software Resource Centre (OSSRC) in India. This is established with a joint agreement of IBM India, CDAC and Indian Institute of Technology, Delhi. The Indian government expects authors to make their works accessible preferably free of charge if they are the result of publicly funded research. And ‘*The Right to Information Act*’, which came into effect in 2005, has had an impact on publicly financed research: since this act was passed, all citizens have had the right to know the results and social benefits of this type of research. Another group of authors (Chan, Arunachalam & Kirsop, 2009) reported the recent announcement by the CSIR in India, urging the establishment of IRs in each of its more than 35 laboratories as well as conversion of all their journals to open access.

3.10 Major Initiatives

Diverse initiatives targeted at improving access to science, technology, and medical research in the developing world has arisen from the 1990s onwards. The following are the most high profile international initiatives mentioned below:

A. Access to Global Online Research in Agriculture (AGORA)

Access to Global Online Research in Agriculture (AGORA) is an initiative to provide free or low-cost access to major scientific journals in agriculture and related biological, environmental and social sciences to public institutions in developing

countries. Launching in October 2003, AGORA will provide access to over 400/1900 journals from the world's leading academic publishers. Led by the Food and Agriculture Organization of the United Nations, the goal of AGORA is to increase the quality and effectiveness of agricultural research, education and training in low-income countries, and in turn, to improve food security. Researchers, policy-makers, educators, students, technical workers and extension specialists will have access to high-quality, relevant and timely agricultural information via the Internet (http://www.aginternetwork.org/en/about_agora/).

B. Deutsche Initiative für Netzwerkinformation (DINI)

DINI, the German Initiative for Networked Information (Deutsche Initiative für Netzwerkinformation), established in 2000, is a coalition formed by German Higher Education Infrastructure and Service Institutions. DINI Certificate for Document and Publication Repositories aims at networking document and publication repositories in Germany by promoting the use of standards, interoperability and cooperation between German Higher Education institutions running digital repositories. The Certificate can also be used as an instrument to support OA. The primary objective of DINI is to create recommendations for standardized and interoperable information services and communication networks in and between universities (http://conference.ub.uni-bielefeld.de/2006/proceedings/dobratz_scholze_final_web.pdf).

C. European University Association (EUA)

The European Association, in January 2007, established a “Working Group on Open Access” in order to raise awareness of the importance of open access issue to the university community and to develop a common strategy for the university sector on key selected issues to be presented to the policy makers. The Working Group recommendations seek also to provide support to European level initiatives promoting IRs in Europe. Its mission is dual-fold: (i) to raise awareness of the importance of the OA issue to the wider university community, both in terms of its impact upon the research process and its financial implications for university libraries; and (ii) to develop a common strategy for the university sector on key selected issues to be presented to policy-makers (http://www.eua.be/Libraries/Page_files/EUA_WG_open_access_1.sflb.ashx).

D. Health InterNetwork Access to Research Initiative (HINARI)

In January 2002 the World Health Organization (WHO) launched HINARI as part of a wider scheme to improve communication between researchers. HINARI provides free or reduced-rate access to over 2000 medical, biomedical and social sciences journals for researchers working in designated countries, via an interface with publishers' websites (<http://www.firstauthor.org/Downloads/openaccess.pdf>).

E. ICRISAT

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), in collaboration with the Food and Agricultural Organization (FAO) of the United Nations, has launched an initiative to promote open access information sources in agricultural sciences and technology in India. The initiative was launched at the first AGRIS workshop on open access in agricultural sciences and technology: Indian initiatives organized at ICRISAT headquarters at Patancheru on 6 and 7 November, 2006 (http://www.moneycontrol.com/news/business/icrisatpartners-launch-open-access-informationagri_250502.html).

F. International Network for the Availability of Scientific Publications (INASP)

INASP, a UK-based charity, has worked with partners across the world to facilitate access to online publications through workshops, training, library capacity building, and skills development. INASP also recognizes the importance of outreach programs to rural communities, particularly in view of agricultural research and health interventions (<http://www.inasp.info/file/3d034b8bae0a3f7e1381979aedc356a9/about-inasp.html>). It's mission is to enable a sustainable network of stakeholders that owns and drives access, use, dissemination and communication of research information (<http://www.apc.org/en/about/funders/international-network-availability-scientific-publ>).

In addition, a few research funding organizations in both the public and private sectors have adopted international OA principles to mandate or encourage researchers to deposit funded research results in OARs. There are an increasing number of individuals who actively advocate the adoption of OA principles and practices, among the best known of whom are Dr Peter Suber, Professor Steven Harnad and, in Australia, Professor Arthur Sale. All have long played central roles in the advocacy of OA, particularly through their writings on OA developments worldwide, newsletters, blogs and journal articles.

3.11 Major Projects

This section discusses the major projects related to the OARs development worldwide. The main objective is providing a brief overview of those projects having international importance and significant contribution in the open access to knowledge movement worldwide.

A. Academic Research in the Netherlands Online (ARNO)

In the Netherlands, ARNO (Academic Research in the Netherlands Online) was a project that ran from 2000 to 2002 in order to design and implement digital archives to preserve university output. The ARNO project aimed to develop and implement university document servers to make available the scientific output of participating institutions (<http://www.uba.uva.nl/arno>). It is funded by IWI (Innovation in Scientific Information Supply). Its main goals were (i) to couple document servers to international distributed digital archives and to the Dutch national information infrastructure, (ii) to couple the developed infrastructure to the production processes of scientific publishers and form a basis for peer review, and (iii) to connect it seamlessly to digital learning environments (<http://www.h-net.org/announce/show.cgi?ID=127076>).

B. Australian Research Repositories Online to the World (ARROW)

The Australia is another country with important national IR projects. ARROW project is a national demonstrator project funded by the Australian Commonwealth Department of Education, Science and Training, under the Research Information Infrastructure Framework for Australian Higher Education for the support of digital repositories of Australian content (http://en.wikipedia.org/wiki/Australian_Research_Repositories_Online_to_the_World). ARROW project identified and tested software solutions for building repositories to handle eprints, electronic theses and dissertations, e-research and electronic publishing. The project also developed and now offers the Arrow Discovery service that uses harvested metadata from all the ARROW repositories. It aims to provide easy free access to full-text research output which has been deposited into individual repositories at universities, the National Library of Australia and other research agencies such as Australian Policy Online (<http://www.intute.ac.uk/cgi-in/fullrecord.pl?handle=sosig1134559530-9424>). The main objectives of the ARROW Projects are mentioned below (<http://metadata.cetis.ac.uk/implementations/repositoryServices>):

- to identify and test software to support best-practice institutional digital repositories at the ARROW Consortium member sites to manage e-prints, digital theses and electronic publishing; and
- to develop and test a national resource discovery service using metadata harvested from the institutional repositories by the National Library of Australia.

C. Canadian Association of Research Libraries (CARL)

In 2002, CARL began a project to implement IRs at several Canadian research libraries—ensuring that Canadian institutions remain at the leading edge of innovation in scholarly publishing. The CARL project aims to facilitate the sharing of

best practices and lesson's learned for building and implementing IRs at Canadian libraries (<https://dspace.ucalgary.ca/handle/1880/360>).

D. Data Providers for Academic E-content and the Disclosure of Assets for Learning, Understanding and Scholarship (DAEDALUS)

The DAEDALUS Project, funded by the FAIR (Focus on Access to Institutional Resources) Programme in the United Kingdom, aims to set up a range of IRs. DAEDALUS is a project concerned with the establishment of a range of OAI-PMH-compliant digital collections at the University of Glasgow. It runs until July 2005. The project aims to establish a network of OAI compliant collections at the University of Glasgow. It has two strands: service development and advocacy. It will also address issues such as quality control, intellectual property rights and institutional support (<http://eprints.gla.ac.uk/115/>).

E. Digital Academic Repositories (DARE)

DARE (Digital Academic Repositories) is a collective initiative by the Dutch universities to make all their research results digitally accessible. The objective of this project is to make digitally accessible the research results of Dutch universities and research institutes by building distributed archives (<http://www.surf.nl/themas/index2.php?oid=18>). These archives are to be connected with each other and with international initiatives using the OAI protocol. DARE run from 2003- 2006. Between 2003 and 2006, DARE worked to coordinate repository development on a national scale and linked all thirteen Dutch universities and three major academic institutions to form DAREnet. In 2003, the main goals were to (i) implement a basic infrastructure of repositories and (ii) to stimulate the supply of scientific research material.

F. Dataset Acquisition, Accessibility, and Annotation e-Research Technologies (DART)

The Project DART is a Commonwealth Department of Education, Science and Training (DEST) funded project to develop and assess new e-research collaboration tools and infrastructure. The specific goal of the DART project is to support and enable researchers, end-users, and appropriate computer systems to manage the creation and collection of data and to gain greater access to data and documents, by gathering, managing and archiving data and documents and managing their access, so that researchers are more easily able to perform their work and do so at a much higher level of insight and productivity than was previously possible, and so that the Australian public has greater visibility of, and access to, publicly funded research (<http://ausweb.scu.edu.au/aw06/papers/refereed/treloar/paper.html>). The project investigated the most appropriate response to the challenges inherent in new forms

and producers of raw data, new forms of collaborative research activity, new forms of publication, and new forms of research validation.

G. Digital Repository Infrastructure Vision for European Research (DRIVER)

It is an EU (European Union) funded project that sets out to build a test bed for a future knowledge infrastructure of the European Research Area, it has ten partners from eight EU countries, and is the largest initiative of its kind. The project aims to provide a unified approach to manage a challenging and evolving Digital Repository landscape by building an infrastructure for sharing content and functionality (http://en.wikipedia.org/wiki/Digital_Repository_Infrastructure_Vision_for_European_Research). It is a multi-phase effort whose vision and primary objective is to create a cohesive, robust and flexible, pan-European infrastructure for digital repositories, offering sophisticated services and functionalities for researchers, administrators and the general public (<http://www.driver-repository.eu/>).

H. Focus on Access to Information Resources (FAIR)

The FAIR programme - funded by the UK Joint Information Systems Committee - consists of 14 major projects, bringing together over 50 UK universities. This programme is inspired by the vision of the Open Archives Initiative (OAI), that digital resources can be shared between organisations based on a simple mechanism allowing metadata about those resources to be harvested into services. The objectives of the project are to investigate the technical, organisational and cultural processes involved in providing access to institutional digital resources.

I. Rights Metadata for Open Archiving (RoMEO)

The RoMEO (Rights Metadata for Open Archiving) project aimed to find out how the rights status of open-access research papers might be communicated digitally through rights metadata. The project focused mainly on copyright issues related to self archiving eprints. The main aim was to understand stakeholders' needs in relation to intellectual property issues that arise with self archiving and OAI-PMH. An important product was the creation of a database of copyright policies from commercial publishers. This product, known as RoMEO, is now run by SHERPA and is a valuable tool for repository managers, summarizing the permissions that are normally given as part of each publisher's copyright transfer agreement. A particular focus was to find out how rights metadata might be disclosed and harvested under the Open Archives Initiatives Protocol for Metadata Harvesting (OAI-PMH). RoMEO argues that the best way of dealing with the important rights issues created by the open archives, and illustrated by their research, is to develop machine-readable metadata schemes, compatible with OAI-MHP, to describe ownership and usage rights in the article and in the metadata itself (<http://www.lboro.ac.uk/departments/lis/disresearch/romeo/>).

J. Securing a Hybrid Environment for Research Preservation and Access (SHERPA)

The SHERPA project has been set up to encourage change in the scholarly communication process by creating open-access institutional e-print repositories for the dissemination of research findings. The project aimed to develop and promote a favourable environment for the UK's research output (namely e-prints) to be made available. One of the main outcomes was the production of a large body of repository advocacy material that has been widely used by start up repository projects. Currently, as SHERPA Plus, the project is aiming to provide a proactive national information point on IRs, offering seminars, courses, email discussion lists, among others. It is the successor of the RoMEO project. The outcomes of the project will be to advice on the building and maintenance of IRs, guidelines on IPR and copyright issues, quality control, collection development policies, business models and advocacy material to publicise an institution's repository. It aims to set up OAI-compliant e-print repositories (using EPrints software) at each of the partner sites. It focuses on the development of OARs of research output (<http://www.sherpa.ac.uk/>). The focus is on institutionalization and scaling up open access experiments (<http://www.sherpa.ac.uk/>).

K. Simple Web-service Offering Repository Deposit (SWORD)

It was developed with funding from the JISC, and was made available in March 2007. The project arose through discussions about the lack of a standard mechanism for deposit. SWORD will allow for deposit into multiple repositories from remote locations in a standard way and has been developed to include use within generic java server, DSpace, Fedora and EPrints environments (<http://www.jisc.ac.uk/whatwedo/programmes/reppres/tools/sword.aspx>). The project aims to improve the efficiency and quality of repository deposit and to diversity and expedite the options for timely population of repositories with content whilst promoting a common deposit interface and supporting the Information Environment principles of interoperability (<http://www.ukoln.ac.uk/repositories/digirep/index/SWORD>).

L. Targeting Academic Research for Dissemination and Disclosure (TARDIS)

The TARDIS project, run by Southampton University, is planning to develop a multidisciplinary institutional e-print archive and assess and evaluate the activity within a library-led infrastructure. It is designed to tackle head-on the major problem faced by IRs, namely the lack of participation by faculty: It will investigate and report on strategies to overcome the technical, cultural and academic barriers, which currently restrict the development and particularly the acquisition of content of institutional e-Print archives. It will develop a working model of a multidisciplinary institutional archive." The archive will be accessible through the University Library's Web Portal as part of an integrated institutional and subject-focused information

resource. The potential for delivery through an external service provider will also be assessed (<http://www.jisc.ac.uk/whatwedo/programmes/fair/tardis.aspx>). The project investigated the social and technical issues for setting up a repository. In particular it enhanced the EPrints software package and addressed issues related to metadata and multidisciplinary requirements for IRs. The project was led by the University of Southampton and led to the creation of the institutional repository e-Prints Soton.

M. Making Institutional Repositories A Collaborative Learning Environment (MIRACLE)

The MIRACLE Project is funded by the IMLS (Institute of Museum and Library Services) and investigates the development of institutional repositories in colleges and universities to identify models and best practices in the administration, technical infrastructure, and access to repository collections. This project began in 2005 and was originally scheduled to finish in 2008. The results of this census of IRs in the US (Rieh et al., 2007b) are reviewed in a subsequent section Content and item types in IRs. Their project plan indicates that they are currently involved in investigating how people search, retrieve, and use IR resources through an analysis of transaction logs and experimental search test tasks. However, this stage of the research project is not scheduled to be finished until August 2009, so the results cannot be reviewed.

3.12 Problems and Prospects of Indian Institutional Digital Repository (IDR)

Setting up of an IDR needs a planned approach for the implementation tasks defined by their governance structure, management framework, operational strategies and a well documented workflow. Adoption of the standards and choice of models are critical factors for developing an IDR system. More than two thousands IDRs have been set up in the world, and India with eighty (80) IDRs as listed in ROAR (ROAR, 2012) database leads the developing countries with in this regard. Most of the IDRs particularly in India have neither preferred the governance and management structures nor documented the procedures and practices. A good number of institutions in India have already set up IDR but did not make the contents OA due to various reasons. The barriers are various and derived from the different stakeholders such as organization, funding body, publishers, academicians, administrators, and the governmental policies. In addition, several other technical and non-technical issues are considered as barriers of developing IDRs. The following are the major problems of Indian IDRs along with the tentative suggestions to overcome the problems.

A. Problems

India has seen rapid and drastic growth in digitized and born digital data. The main barrier to OA in India is undoubtedly the absence of a national mandate on OA publishing. University Grants Commission (2005) and National Knowledge Commission (2007) recommendations include a statement of OA in its report but six (6) years after the recommendations no formal move has been made towards OA mandates. On the contrary it is still the belief that resources such as research articles in OA are not standard and do not have the authority stamp of '*peer reviews*'. Among the reason for this are lack of awareness of citations (Arunachalam & Muthu, 2011), poor subscriber base and preference of the scientists to publish in foreign journals that have much higher impact factor than the Indian counterparts. Lack of funding and mandate towards publishing in IDRs could be one more reason. This section summarizes problems of India IDRs and discusses barriers to implementation. The major problems are summarized and discussed under the following six (6) major groups/or headings:

A.1 Problems related to Policy

The growth and success of any digital repository systems depend on proper policy documentation. As stated in section 4.2.1 of chapter 4, majority of the repositories do not have well defined policy (vide Table 4. 2 of chapter 4) regarding organization and management of resources, document types or contents, archiving, submission, workflow, legal contributor, access to contents, quality of contents, versioning, publicity and branding, copy right and licensing, embargo period, preservation and data backup, file formats, metadata, removal or withdrawal of contents, etc. There is no initiative to setting up Registry of Indian repositories in line with ROAR and OpenDOAR registries.

A.2 Lack of Institutional Mandate at National Level

There is as such no mandate to dictate that publicly funded research should be reported in OA journals and repositories. There is no legislative provision at national level to make it mandatory to submit research output into IDR. Though UGC and National Knowledge Commission made recommendations (vide section 3.9 of this chapter) include a statement of OA in its report but no formal move has been made towards OA mandates.

A.3 Problems related to Stakeholders

Scientific community is yet to be fully aware of the potential of open access to scholarly information. Advocacy attracts contributors as well as stakeholders. Ignorance or lack of knowledge of repository seems to be one major issue to the development of OARs in

developing countries. Different parties are involved with the repository system in an organization such as researchers, faculties, authors, users, administrator, policy makers or government etc and their active involvement and participation is essential for smooth running of a repository system. It is only when this ignorance is tackled that any meaningful progress can be made. In addition, professional organizations like DELNET, INFLIBNET have major role in making awareness of open standard, open source, open access followed by academic organizations and government organizations respectively. The key findings can be summarized as below -

- Lack of support from author side in publication process due to simple and user-friendly depositing process;
- Lack of awareness-raising efforts among the academics;
- Lack of awareness among user and IDR team in absence of appropriate literacy program;
- No proper training for users, researchers, academicians, authors and administrators;
- Lack of an institutional accountability policy;
- Lack of financial support from national funding body; and
- Lack of coordination among higher authorities.

A.4 *Access related problems*

In order to increase acceptance, access and impact, it is not enough to simply upload content on servers. There are many problems related to the non-availability of the facility to download full text OA articles. Repositories do not provide full text access to their resources and only metadata is searchable. Even repositories follow different access policy for different type of users (vide section 4.2.1.5 of chapter 4). Another problem is non-availability of non-textual objects such as learning objects, multimedia, software, patent etc. (vide section 4.2.1.3 of chapter 4).

A.5 *Problem related to Multilinguality*

As stated in section 4.2.1.8 of chapter 4, this study recommends that repository system should be Unicode-compliant and multilingual in nature in order to support processing and retrieving of Indic-script based languages. But repositories are not Unicode compliant and major portion of their collections are based on English language (vide section 4.2.1.3.1 of chapter 4). The key findings are

- Non-availability of documents other than default English language;
- No such provision for multilingual information processing, searching and retrieval;
- No such provision for multilingual interface for end users;
- No such provision for metadata for multilingual texts;
- Lack of standard encoding format for documents; and
- No mechanism for translating Indic script base languages.

A.6 *Technological problems*

Majority of the IDRs initially faces the problems regarding software such as installation, up-gradation, customization; maintenance and back up databases.

'*Technological obsolescence*' is also big challenge for repository system. The other key findings are

- Lack of proper quality control mechanisms;
- Lack of review and technical evaluation of the document;
- Non availability of IDRs in World Area Network;
- Lack of expertise or lack of technical knowledge in handling open source IR software;
- No proper mechanism for harvesting metadata from OAI-PMH compliant repositories;
- No standards exist for access statistics;
- No system for feed back mechanism;
- No such provision for incorporation of social networking software (e.g. Blog, RSS etc.);
- Repositories do not support OAI-PMH verb;
- Lack of search services as provided by national and international gateways;
- Lack of integration with other national and international systems;
- Vocabulary control along with authority control; and
- Lack of comprehensive and up to-date selection tools for preservation of digital documents.

A.7 *Problems related to Standard*

Generally digital library system is based on distributed network that is compatible with globally agreed upon standards. It is essential to follow standards in the domain of automated and digital library systems. But majority of IDRs do not follow global standards and specifications in the following areas -

- Domain-specific metadata schemes to describe non-textual objects;
- Interoperability;
- Resource discovery and identification;
- Software;
- Encoding;
- Data formats;
- Import/export;
- Network;
- Vocabulary; and
- Citations.

Any of these failures mentioned above can result in the failure of repository, disruption of access, or worse, total and permanent loss of material stored in the institutional repository.

B. Suggestions

While there is a progressive growth of digital libraries and IDR in several developed countries like USA, UK, Germany, Australia and many countries in Europe, India is witnessing moderate growth. India has adopted the Open Access model much ahead than other developing countries

Indeed, many ETD initiatives are from institutes of national importance. Universities and other academic and research institutes are lagging behind in this direction. However it can be said that OA acceptance is growing both in public sector information as well as in academic institutional mandates. A set of minimum requirements of a repository is formulated. At the same time BURA makes recommendations highlighting foreseeable developments that might turn into future requirements. Further research is required to finalize the model and based on the findings of this study, the following recommendations are made to overcome the problems –

B.1 *Formulation of Policy*

Formulation of policies is the key to success of repository system. It is essential to have a well defined policy (vide section 4.1.1 of chapter 4) for any IDR system. Several experts recommend formulation of policies in different key areas as stated above for smooth running of the system. So, formulating policy in the line of global recommendations and best practices is another key to success of the system.

B.2 *Promotional and awareness raising programme*

People are not much familiar with the term OA and OARs. So promotion and marketing of repositories in order to create awareness among different stakeholders (e.g. authors, academicians, researchers, policy makers etc.) has become an essential role for repository manager or administrators. Arranging awareness raising campaign, workshops, conferences, seminars and providing hands on training to stakeholders for creating expertise in setting up repositories is essential to solve the problem. There is a need for raising awareness within the community about the IDR and to encourage wider contribution of contents to the IDRs. In this regard, Government should come forward to pass the legislation in parliament for enabling open scholarship of publicly funded research. There should have a cordial relationship among all parties including government and other professional organizations like INFLIBNET, DELNET etc. involved with the system.

B.3 *Establishing Nation-wide Network*

Repositories should network and interconnect. Still now, Indian IDRs are working in isolation as because there is no network at national level. This interconnection can be on different levels, e.g. regional or state-wide, national or international. It is essential to set up a registry of Indian IDRs like ROAR and OpenDOAR databases so that organization can register their repository. In addition, it has to be integrated with other national and international systems.

B.4 *Technological parameters setting*

Developing repository using software (commercial or open source) is not the solution. Several other parameters such as operating system, hardware, network components, web Server etc. (vide section 4.2.1.17 of chapter 4) has to be properly considered. Software is to be customized to meet the local requirements and there should have

- Provision for incorporation of domain specific metadata schemas;
- Provision of persistent identifier for unique identification of documents;
- Provision for supporting OAI-PMH verb;
- Provision for proper mechanism for access statistics;
- Provision for incorporation of social networking tools;
- Provision for developing federated search option for multiple OARs;
- Provision for inclusion of Indic script based subject access system; and
- Provision for development Unicode-compliant interface.

At the end, software architecture is to be designed in such a way where all the supporting software can be integrated seamlessly with the proposed model.

B.5 *Application of Open Standards*

Achieving technical interoperability is one solution to make the contents searchable globally. It can be done through following open standards, open technologies and open source software. Seamless integration and sharing of knowledge resources can only be possible if standards are properly followed. Once it is done, Indian repositories will work in a networking environment and will be part of the global knowledge system.

B.6 *Multilingual document processing and retrieval*

As stated earlier, India is a multilingual country having different regional languages with many variations of dialects. So incorporation of multilingual documents into IDRs and provision of browsing, searching, processing and retrieving Indic-script based documents is mandatory for Indian IDRs.

Though IDRs are at a critical point in their development but there is scope for developing a 'Best Practice Guidelines' for Indian IDRs. Recently there is a growing trend of establishing IDRs throughout the world and governments including universities and funding bodies are taking key roles in promoting open access to public funded research outputs. To bring them to greater success it is necessary to standardize further developments. It is necessary for India to have a network of National Digital Library centers to spearhead the process of ETD movement. To reach this goal it is necessary to network document and publication repositories. It is deemed important to develop this according to international standards and to use

proven technology. The public-private partnership in this movement is also growing and national movement is being initiated at this juncture to create awareness about the IR. The major research funding agencies in India like AICTE, CSIR, ICMR, UGC, and other organizations are insisting their affiliated bodies to design and develop an IR and mandating compulsory submission of research data. So, it may be concluded that if the strategies are implemented, policies are formulated in the line of global recommendations, standards are followed in a calm and orderly way, Indian repositories are expected to be more successful. If properly implemented with the existing practices, IDRs has the potential to fulfill many unmet expectations.

Chapter 4

Designing a Model IDR for the University of Burdwan



“Everything is theoretically impossible, until it is done”.

Robert A. Heinlein (The
Rolling Stones, 1952)

Structure

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4.0. Introduction

This chapter deals with designing theoretical framework of the model BURA (Burdwan University Research Archive) and also describes different core components of the model. The chapter consists of three parts and categorized as namely policy issue, standards and software selection. Critical and crucial issues related to non-technical category such as policy regarding collection, access to collection, information model, security, contents, user interfaces, preservation and back up, metadata, withdrawal policies, multilingual resource management (storing, processing and retrieval), IPR etc. (Table 4.2) have been discussed. This chapter concentrates on the policy and cultural aspects of implementing IDRs. As many experts in the field state, establishing the technological infrastructure is not difficult, as long as the organization has access to the right technical support. The hard parts to repository building are deciding policy on the contents, preservation and back up, copy right, file format etc. mentioned above and then actually getting the contents in. This chapter explains why a model is required for the academic institutes in general and the University of Burdwan in specific. Another part is selection of standards and software for the model. This part includes different technical components require for clustering the model framework. This chapter describes steps and processes to develop software framework along with purpose, essential features and necessary components for each cluster under the general architecture of IDR system.

This model recommends use of open standards and open source software (OSS) and universal character sets in building the software framework for BURA. All the software and standards are free of cost and software can be customized as per the needs of the organization. The system is based on common global standards in respect of software, data formats, metadata, access, network and interoperability etc. This part describes different metadata schemas for different types of objects and suggests for best schema for specific object type. However, the software framework has the provision to implement the policies related to ownership issues, pre-post and print rights along side distribution policies that are formulated in accordance with the IPR relating to each IDR's perview. The core issue of the software framework is to describe technical issues related to platform, DBMS (Database Management System), Server etc. This part of research report provides basic information about the pre-requisites of the IDR software such as Platform, Database, Access and Mail server required running the software and the next part provides basic information and general overview about different IDR software. The chapter outlines different IDR software and presents a list of features of those software to justify its choice for IDR system. The final step is clustering of the model consists of three major parts namely Basic Cluster, IDR Cluster and Multilingual Cluster. The software framework is divided into three clusters mentioned above keeping in view the user needs, administration of system, value-added features, essential components, and accommodative architecture of the model.

This chapter explores the possibilities of application of global standards recommended by researchers and experts in the domain of digital archiving in view of the needs for standards for different types of documents such as e-theses, learning objects etc. This chapter also presents a method of metadata harvesting framework from different OAI-PMH compatible OARs in a single-window search interface. This framework has developed a prototype union catalogue of OARs to facilitate retrieval of OA resources on global scale from a single-window search interface.

4.1 Need of a Model for Indian Universities

A number of institutions have begun to develop institutional digital repository (IDR). Many are well beyond the conceptual stage in their implementation, and many are operating with a limited scope. A model is required for smooth functioning of a repository system. It will provide institutional managers the flexibility to control all the issues as to who can contribute, approve, access, and update the digital contents coming from a variety of institutional communities and interest groups (including academic departments, libraries, research centres and labs, and individual authors). The model will specify the responsibility of all members involved in this system and guide them in all circumstances. This model will act as a manual for the university authority for taking decisions on the above stated issues. Actually, the IDR model for The University of Burdwan is required only for the main four reasons:

- support open access trends in scholarly communication;
- support open access to knowledge movement;
- public funded research should be made publicly available; and
- unique list of resources produced by the members of the university.

In this situation a model based on global standards and best practices is required for Indian universities that will organize and preserve university's intellectual resources for future use and will provide global access to Indian research. Once the model is implemented it (system) is expected to perform the following tasks:

- act as a tool for preserving university's research outputs for future use;
- act as a tool to assist a university in its digital publishing ambitions; and
- act as a tool to enable universities offer digital courseware and online learning.

4.1.1 Need of a Policy for the University of Burdwan

Devising IDR policies is an important, necessary, and complex activity during IDR implementation. One of the most complex, and often unexplored, aspects of creating an IDR is setting its policies (Barton & Waters, 2004–2005; Jones, Andrew &

MacColl, 2006). In order to ensure that IDR uptake and use is achieved, there are certain policy considerations that must be made before implementing an archive. The need for a policy to guide the operation of the repository is an important factor to be considered (Asamoah-Hassan, 2010). Clearly a policy is crucial in setting the parameters of the system. Gutteridge & Harnad (2002) discussed policy decisions and suggested a possible policy based on their experience. Rieh et al. (2008) cautions that policies must take into account stakeholder needs, and existing research practices.

In India for several years, universities and research/or funding agencies have generated valuable knowledge resources in the form of theses, dissertations, project reports, courseware, pre-prints, etc through research and development activities. The University of Burdwan is not the exception. Our faculties, research students are generating scholarly contents but there is no mechanism for holding such intellectual output of the University to support open mode of scholarly communication. As a result, these resources are inaccessible to even stakeholders in the absence of appropriate open access mechanisms. Even those resources that eventually appear in print and are published may still be inaccessible to a vast majority of institutions due to the high cost of subscription to the source material in which they are published. But the problem is that University Grants Commission (UGC) has not suggested any guidelines and has not recommended any best practices for setting up repository for universities. There is no formal move has been made towards OA mandates and absence of a national mandate on OA publishing. No consensus has been built on different technical and non-technical matters. Even our IDRs are not following global recommendations and universal standards in terms of interoperability, software, access, metadata schemas, storage, format, etc. (Table 4.2). As a result Indian repositories are working in isolation and there is no networking among IDRs. There is no sharing of resources. But open access to knowledge and seamless integration of these knowledge resources are possible through application of open technologies, open standards, open source software because digital library system is based on and is operating in distributed network environment compatible with globally agreed upon standards related with information processing.

So here lies the importance of formulating a policy for IDR based on global recommendations. Clearly formulated policies will help to address legal issues and will also develop good administrative practices. This research study recommends a policy document against selected parameters (Table 4.2) where all the IDRs would work in one network following same standard and protocol in all respect and resources would be retrievable seamlessly globally. This policy document will be helpful to those planning to set up repository for their own. If the strategies are implemented, standards are followed, policies are formulated in calm and orderly way, IDRs in true sense is an economic publishing model of this electronic communication process and it will be retrievable through Web.

4.2 Components of the Model (BURA - Burdwan University Research Archive)

This research work identifies fifteen parameters/or components (Table 4.2) essentials for designing techno-organizational model like BURA (Burdwan University Research Archive). These components are constructed to incorporate required features of the model. These parameters are considered essentials for designing university-specific IDR system. This particular section discussed all those parameters and made recommendations in selecting parameters for the theoretical framework of the model BURA.

4.2.1 Policies

There are not yet, and perhaps never will be a set of unified digital repository best practices. Organizational needs are too diverse to support a single group of recommendations that would function well in all environments. However, broad frameworks and reference models do provide overall guidance. In a survey for OpenDOAR (Directory of Open Access Repository) in early 2006, Peter Millington discovered that about two thirds of open access repositories did not have publicly stated policies (Millington, 2006). In order to examine the development of open access (OA) mandate policies, this study consulted ROARMAP (Registry of Open Access Repository Material Archiving Policies), a site created and maintained by the University of Southampton in England as an online location for policy registration. The study consulted with other important sources like OpenDOAR and ROAR (Registry of Open Access Repository) databases to improve the accuracy level. Other sources consulted included SHERPA/RoMEO (Securing a Hybrid Environment for Research, Preservation and Access/ Rights METadata for Open archiving) Publisher copyright policies and self-archiving policy list; Sherpa Juliet's research funders' open access policy list, which has a list of unanimous faculty votes for institutional mandate policies. As per ROARMAP database (<http://roarmap.eprints.org/>), a total of 439 policy proposals and implementations have been registered and documented (Table 4.1). This research work compiled and analyzed a total of 439 mandate policies: both implemented and planned. However, several policies are missing from the list. Some of the policies used by these repositories are still being developed and improved. At the time of writing (June, 2013) there were in total 439 mandatory OA policies in force from research funders (81 policies), universities and research institutes (178 policies) and individual departments, faculties or schools in research-based institutions (40 policies). Mandatory policies covering doctoral and master's theses have also been introduced in some institutions (105 policies). The figure (4.1) shows the growth and cumulative pattern of mandatory Open Access self archiving policies over the last decade.

Total Policy	Institutional	Multi-Institutional	Sub-Institutional	Funding Agencies	Thesis	Unspecified
439	178	6	40	81	105	29

Table 4.1: Number of Mandate Policies (by Type)

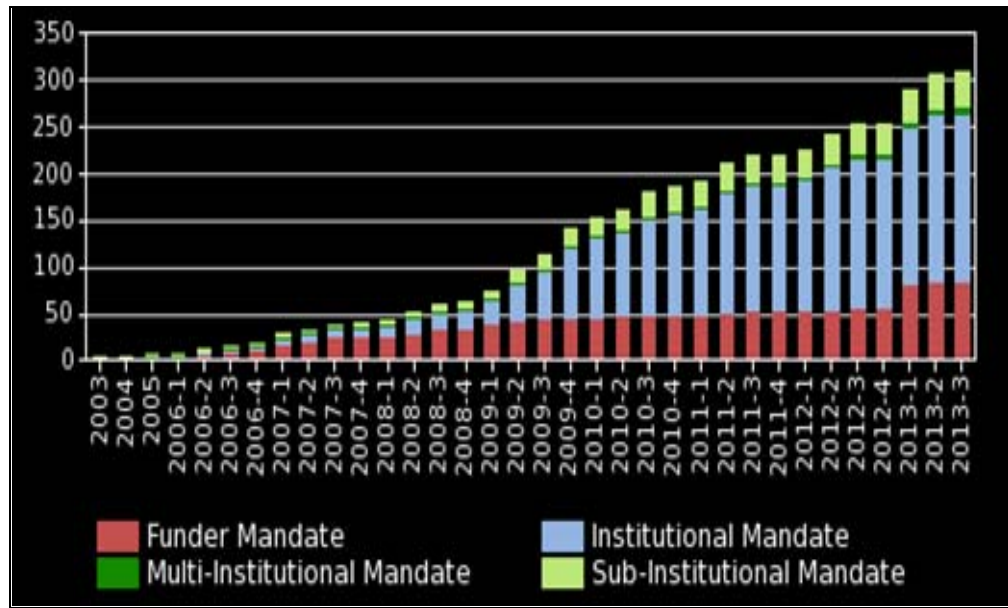


Fig. 4.1: Growth of Mandatory Policies on Open Access (data for years 2006 onwards shown by year-quarter) (Source: ROARMAP, 2012)

During data collection, this research study took care and became aware of some problems in the comparison, because many repositories with a mandate do not have a corresponding entry on the OpenDOAR or ROAR databases. Some repositories having OA mandate did not register its name in ROARMAP and their URL (Uniform Resource Locator) are not properly working. Some policies may be listed under a different name or entered incorrectly. The following analysis took this limitation into consideration. There are nonetheless many thousands of universities, research institutes and research funding agencies across the world that have not yet implemented an OA policy. This work has identified these common areas where policy is required for smooth functioning of a repository. In keeping with that commitment, BURA (Burdwan University Research Archive) adopted the following policies against selected parameters (Table 4.2). The following policy areas will all contribute to creating a repository that is well run and well used in the long term.

Policy	Activities related to Policy
Archiving Policy	Mandatory or optional; time; form & format
Collections Organization and Management Policy	Organization & management; categories & sub-categories; browsing services
Contents Policy	Type of material; languages
Copyright and Licensing Policy	Right management; licensing pattern
Data Access Policy	Access to items; access pattern; re-use of items
Embargo Policy	Length of time
Metadata Policy	Access to metadata; re-use of metadata; eligible depositors; authentication; schema used
Multilingual Policy	Incorporation of Indic-script based documents; Browsing & searching of multilingual resources; subject access support system
Preservation Policy	Retention period; file preservation; functional preservation; backup
Quality Control Policy	Eligible reviewer; mechanisms
Submission Policy	Eligible contributors; deposition rules; moderation, workflows
System Management and Administrative Policy	Control & management; responsible person; proper location
User Interface	Unicode-compliant multilingual interfaces; mechanisms for browsing & searching multilingual resources
Version Control Policy	Multiple version control; up-gradation; errata and corrigenda lists
Withdrawn Policy	Reasons for withdrawal or removal

Table 4.2: Policies against selected Parameters for the BURA

4.2.1.1 Archiving Policy

Determining the Archive policy is the most important component for generating contents of the archive. In the Archiving policy, four major issues have been identified i.e. *mandatory or optional*, *archiving format*, *when to archive* and *version to be archived* (Table 4.3). The first question is what kind of policy is followed by the institute maintaining the digital repository towards the academics with regard to depositing material? The deposit policy can be determined as optional or mandatory.

By applying optional deposit policy, only a small portion of research output of the institutions will be available. Therefore only the mandatory policies can be effective for avoiding this, encouraging wider contribution, and ensuring the institutional repository contents. So institutions with voluntary policies (initially more popular) are now opting for mandatory policies. The trend appears to be moving towards mandatory deposit, but each institution needs to set the policy that best meets its own local conditions.

Consideration: Mandatory or Optional

View of Researcher(s)

There is consistent evidence that mandatory policies produce higher levels of self archiving (Graaf & Eijndhoven, 2008; Ware, 2004; Sale, 2006a, 2006c; Gibson, 2005; Pinfield, 2004, 2005; House of Commons Science and Technology Committee Report, 2004; Harnad, 2006a, 2006c; Rowland et al., 2004; Swan & Brown, 2005; Pickton & McKnight, 2007). Several institutions have already applied a mandatory policy, for instance University of Glasgow, where this service is provided by librarians (Ashworth, Mackie & Nixon, 2004). Kennan & Kingsley (2009) reported that five other Australian universities have indicated they are intending to implement a mandatory deposit policy. Another funding body, the US National Institutes of Health and Australia's National Scholarly Communications Forum followed with similar announcements (Chan, Kwok & Yip, 2005). University Grants Commission (2005), India partially supports this view and recommends submission of electronic version of the doctoral thesis a mandatory requirement for all doctoral students. Another study (Gargouri et al., 2010) shows the levels of OA in IRs with mandatory policies compared to the level of voluntary self-archiving (Fig. 4.2).

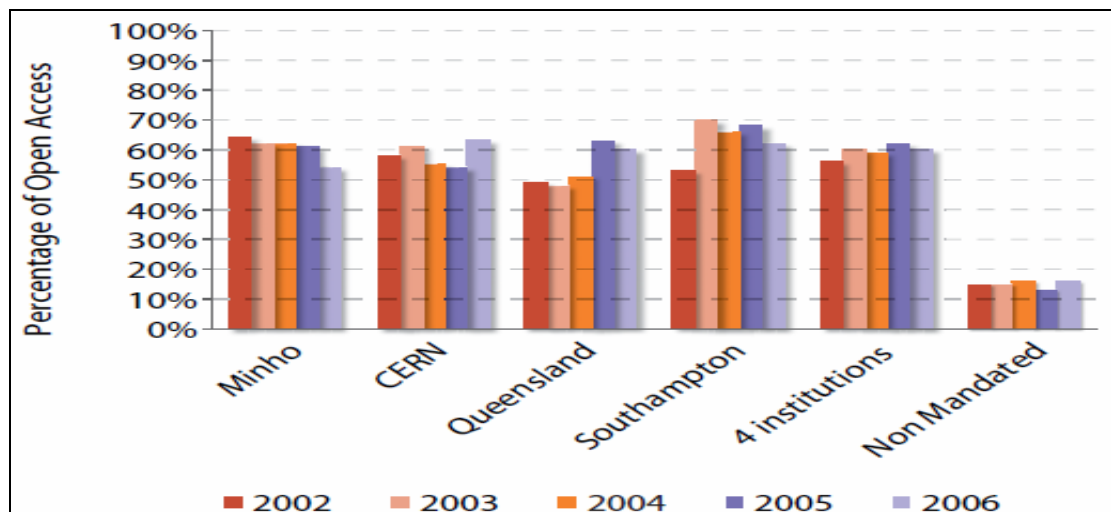


Fig. 4.2: Percentage of the total institutional journal article outputs made Open Access by self-archiving in repositories at four Institutions
(Source: Gargouri et al., 2010)

This study shows that mandatory policies at institutions succeed in accumulating contents in their repositories, averaging 60% of total output after a couple of years of the policy being in place. Another study (Key Perspectives Ltd., 2005) conducted a survey and showed the view of researchers at universities worldwide (Fig. 4.3).

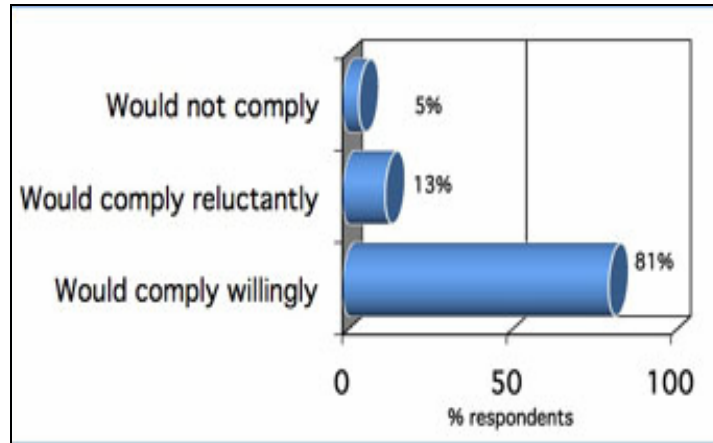


Fig. 4.3: Researchers and Open Access Policies
(Source: Key Perspectives Ltd., 2005)

Analysis of Roarmap Database

It is found that only a few repositories explicitly stated that it is mandatory to submit work into the IDR (Table 4.3). The others IDR have no official policy or a different one.

Consideration: *When to archive and which version is to be archived*

Another question is when to archive and which version is to be archived to the repository.

View of Researcher(s)

Stevan Harnad (Harnad, 2006b) advocated archiving author's final accepted refereed draft immediately after acceptance of publication. Over 90% of journals publishers now routinely allow authors to self-archive a copy of the 'accepted manuscript' version of their papers (<http://www.sherpa.ac.uk/romeo/>) and (<http://www.oaklist.qut.edu.au/>). Another study (DINI, 2003) proposed to archive author's uploaded files in original format. The other study (OAIS, 2012) shows the self archiving permissions by journals and publishers respectively. It has been compiled by SHERPA database (Fig. 4.4 & Fig. 4.5).

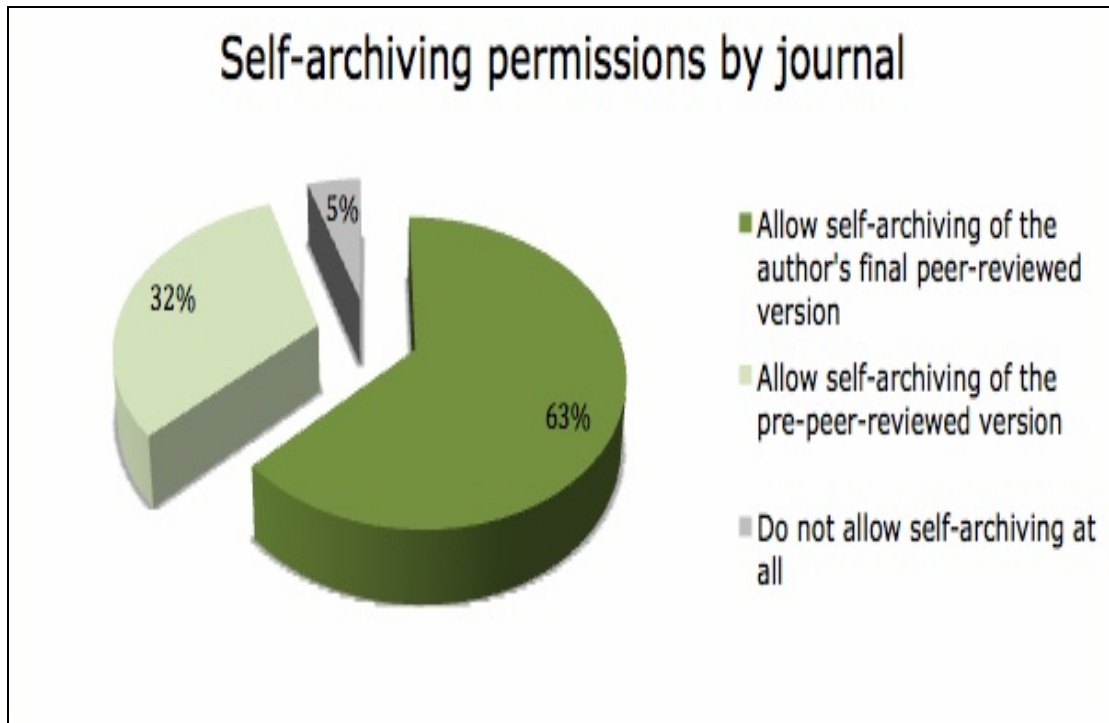


Fig. 4.4: Self-archiving permissions by Journals
(Source: OAIS, 2012)

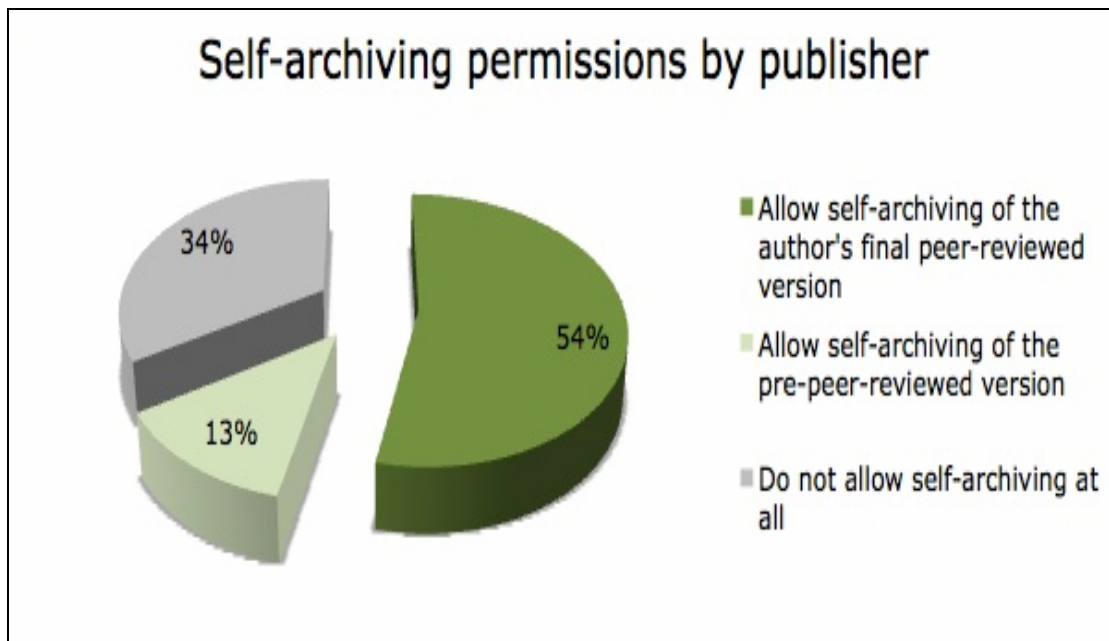


Fig. 4.5: Self-archiving permissions by Publishers
(Source: OAIS, 2012)

Analysis of Roarmap Database

Most of the repositories have no official policy on this issue. All the repositories under study (Table 4.3) support archiving author's final accepted refereed draft immediately after acceptance of publication.

Consideration: Archiving Format

Another question concerned with the archiving is storage format. Repository managers must have a clear policy towards formats they should use to archive contents in the repository (Word files, PDF, html, image files, and so on). There is a wide spectrum of policies on allowable formats, for example some repositories accepting only PDF and some accepting any digital format on the other hand.

View of Researcher(s)

A few IDRs recommended file formats list for different type of documents. Generally repositories support all types of files formats but authors are requested to deposit PDF or HTML files. Plain text files are also supported. Several studies (DINI, 2003; Pappalardo & Fitzgerald, 2007) support this view and suggest archiving documents in PDF format.

Analysis of Roarmap Database

Most of the repositories have no official policy on this issue. But the majority of the IDRs (Table 4.3) recommended for all to deposit full final version of their paper in PDF file (preferred).

Name of the Repository	Policy related to Archiving			
	Mandatory / Optional	When to Archive	What to Archive	Prefer Format
Anglia Ruskin Research Online				Any open formats
Australian National University Research Repository				PDF
Aston University Research Archive				PDF
Australian Research Council		at the earliest possible opportunity		
Bond university				PDF
Brandeis Institutional Repository			Author's final peer-reviewed version	

Name of the Repository	Policy related to Archiving			
	Mandatory / Optional	When to Archive	What to Archive	Prefer Format
British Heart Foundation		accepted for publication	Author's final peer-reviewed version	
Bharathidasan University	Y			
California Institute of Technology			Author's final peer-reviewed version	PDF
California Polytechnic State University				PDF
Canadian Breast Cancer Research Alliance		as soon as possible after publication	Publisher's version / Author's final version	PDF
Canadian Cancer Society Canadian Health Services Research Foundation		as soon as possible	Any publications Published papers	
Canadian Institutes of Health Research		accepted for publication	Author's final peer-reviewed version	
Chief Scientist Office		accepted for publication	Author's final peer-reviewed version	
Cornell University				Plain text, XML, PDF, PDF
CRISAT International Crops Research Institute for the Semi-Arid Tropics				
Charles Sturt University Institutional Repository		accepted for publication	final version	
Dublin Institute of Technology Dunhill Medical Trust		accepted for publication	Author's final version or publisher's version	PDF
E-prints in Library and Information Science				PDF & HTML
European Commission		accepted for publication	Author's final version or publisher's version	PDF

Name of the Repository	Policy related to Archiving			
	Mandatory / Optional	When to Archive	What to Archive	Prefer Format
European Heads of Research Councils		as soon as possible after publication	post-prints (or publisher's version if permitted)	
European Research Advisory Board		as soon as possible after publication	post-prints (or publisher's version if permitted)	
European Research Council		at the date of publication	Author's final version or publisher's version	
European University Association		accepted for publication		
Fonds de la recherche en sante Quebec		after publication or presentation	peer-reviewed publications	
Genome Canada		as soon as possible	peer-reviewed publications	
Ghent University policy			author's version (postprint)	
Indiana University–Purdue University Indianapolis		accepted for publication	final version or version accepted	any standard format
Institute of Education Sciences		accepted for publication	Author's final peer-reviewed version	
Joint Information Systems Committee		At the earliest possible opportunity	Author's final peer-reviewed version or publisher's version	PDF
Leicester Research Archive Policies				PDF
Macquarie University Digital Repository		accepted for publication	Author's final peer-reviewed version	
Madurai Kamaraj University		accepted for publication	Author's final peer-reviewed version	
Medical Research Council		earliest opportunity accepted for publication		
Michael Smith Foundation for Health Research			Author's final version	
National Health and Medical Research Council		at the earliest possible opportunity	Author's final peer-reviewed / Publisher's version	

Name of the Repository	Policy related to Archiving			
	Mandatory/ Optional	When to Archive	What to Archive	Prefer Format
National Institutes of Health		accepted for publication	Author's final peer-reviewed version	
National Research Council Queensland University of Technology	Y Y	accepted for publication	Author's final peer-reviewed version or publisher's version	
Southampton's ECS departmental repository Trinity College Dublin	Y	accepted for publication		
United States Department of Agriculture			final published version	PDF or other standard format PDF
University of Abertay Dundee		accepted for publication	Author's final peer-reviewed version	
University of Barcelona		immediately following publication		
University of Birmingham Research Archive University of Bradford University of Helsinki				PDF PDF Standar dized & hardwar e- indep endent format PDF
University of Huddersfield				
University of Kansas				Recom mend- ed file formats list
University of Loughborough			Author's final peer-reviewed version	Word or PDF
University of Melbourne Eprint Repository				PDF & HTML

Name of the Repository	Policy related to Archiving			
	Mandatory/ Optional	When to Archive	What to Archive	Prefer Format
University of North Texas		as soon as possible after publication	Author's final peer-reviewed accepted version or as allowed by the publisher	
University of Pretoria				PDF
University of Queensland	Y			PDF
University of Reading				PDF
University of South Australia				PDF
University of Southampton Research Repository	Y			
University of Starling (STORRE)		accepted for publication	Author's final peer-reviewed version	PDF
University of Surrey		as soon as possible after publication		
University of Tasmania	Y			
University of Utah's institutional repository			Author's final peer-reviewed version	
Victoria University Institutional Repository	Y			PDF
Wake Forest University			Author's final peer-reviewed version	
Wellcome Trust	Y	as soon as possible	Author's final peer-reviewed version	PDF
Zurich Open Repository and Archive				PDF

Table 4.3: Archiving Policy (analysis on the basis of ROARMAP database)

Recommendation(s)

A set of recommendations are drawn as Archiving policy for BURA on the basis of the discussion made in this particular section 4.2.1.1 and additional note is given below¹:

¹In case of journals articles, SHERPA/RoMEO (<http://www.sherpa.ac.uk/romeo/>) database provides details of the policies of publishers can be checked. And in case of funded research, SHERPA/Juliet (<http://www.sherpa.ac.uk/juliet/>) database may be consulted.

1. *It is mandatory for all to submit work to the BURA;*
2. *Author's final accepted refereed draft is to be archived;*
3. *Paper(s) will be archived immediately after acceptance of publication; and*
4. *Paper(s) only in PDF format will be accepted.*

4.2.1.2 Collections Organization and Management Policy

A Collections management policy is likely to be a central part of a repository system. This policy defines how Collections is to be organized and managed inside the repository and will repository use any vocabulary control device for subject access? Administrator can choose anything keeping in view, the way users expect it to be. Information needs may vary organization to organization and are strongly influenced by the specific circumstances of people and the places in which they live. So resources need to be organized under suitable categories and sub-categories in such a way that should reflect and cover the thrust areas or information demand areas of the community members. There is no hard and fast rule and has flexibility in organization of collections (Fig. 4.6). The resources may be arranged by subject (Vidyanidhi), by collection type (IIT, Bombay) or by departments and school (Cochin University of Science and Technology) and so on. The organization of resources consists of two parts mentioned below:

- Categories and Sub-categories (under community, Sub-community and collection); and
- Browsing and Searching services (browsing facilities by following a standardized schema of classes)

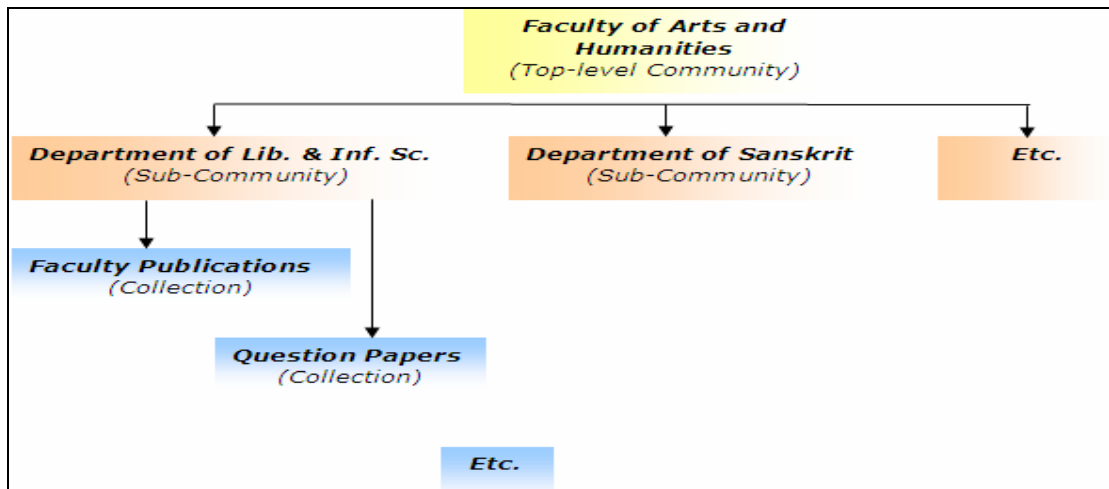


Fig. 4.6: Proposed Collections Structure within BURA

Consideration: How Collections is to be organized and managed

View of Researcher(s)

Generally it is arranged by departments (e.g. product unit) and by subject category (e.g. contents). One study (Proberts & Jenkins, 2006) advocated that contents should be organized under ‘communities’ because organizing contents in this way (under ‘communities’) has the advantage of providing departmental flexibility. Another study (Pappalardo & Fitzgerald, 2007) suggested contents to be organized as many different ways as possible (e.g. subject, departments, authors or years of publications) so that the repository is browsable through as many different ways as possible.

Analysis of Roormap Database

There is no consistency in organizing IDR resources and it varies from repository to repository. It is found that only seven (7) IDRs explicitly stated how their collections were organized (under departments, units or subject categories) and managed whereas none of the institutions had such a policy (Table 4.4).

Consideration: Use of Subject Device for browsing specific Subject

View of Researcher(s)

Providing subject access in any repository system has become essential and another approach to fulfill the subject search of the users. It allows user to choose from a predefined taxonomy of keywords to describe items of information that are being submitted to the repository. That same taxonomy is subsequently used to find and access items held in the repository. It is quite impossible to find out a specific subject term using Community/Sub-community of a repository system. It may be due to the fact that repository may not cover all subjects or Community/or Sub-community may not always represent the actual subject. So it may not be possible for a user to identify the subject or to find out a specific subject term from the resources. So it is essential to have a separate Indic script based ontology driven vocabulary control device that supports browsing and searching specific subject term in regional languages.

But no research works have been reported in this area. Not a single study has proposed using Web-enabled subject access system available in different languages other than default English language.

Analysis of Roormap Database

All the repositories under study have no official policy regarding using of subject vocabulary device to search a specific subject.

Consideration: Whether Communities have the right to design its own policies

Another question is whether communities have the right to design its own policies and guidelines regarding the specific contents/deposit items and submission processes.

View of Researcher(s)

No expressive study has been conducted in this area. There is lack of published literature in this area. The study (Proberts & Jenkins, 2006) recommends that administrator can set different permission policies for different collections (read, remove, add, write etc.) for different types of users.

Analysis of Roarmap Database

It has been shown (Table 4.4) that only two (2) IDRs clearly stated that each community may have the ability to make their own decisions on issues such as the type of material to be deposited and the submission procedures.

Name of the Repository	Managed and Organized by	Policy designed & owned by
Anglia Ruskin Research Online	Communities and Collections	
University of California (CDL)	Departments or Units	
Goddard Library Repository	Projects, Organizational code, Subject, or Author	
HKUST Institutional Repository	Communities and Collections based on Departments or Units	
Massachusetts Institute of Technology (MIT)	Departments or Units	Community may set its own policies and guidelines regarding the specific content/deposit of content and submission processes
Queensland University of Technology	Subject categories	
University of Hawaii at Manoa	Departments or Units	Each collection can have its own submission process & Authorization (Contributors) set out in Community policies
University of Kansas	Communities and Collections	Community may set its own policies and guidelines regarding the specific content/deposit of content and submission processes
University of Utah	Structure depends on the software and technical support	

Table 4.4: Collections Management Policy

Recommendation(s)

A set of recommendations are drawn as Collections Management policy for BURA on the basis of the discussion made in this particular section 4.2.1.2:

1. *Collections will be organized under Academic Departments;*
2. *It will be supplemented by subject scheme (available in Bengali);*
3. *Administrator will add and select E-people for each Collection; and*
4. *Administrator will set different permission policies for different collections (read, remove, add, write etc.) for different types of users.*

4.2.1.3 Contents Policy

In the Contents policy it should be stated what type of materials will be accepted and stored in the repository. There is no hard and fast rule regarding contents type because the structure of the archive depends on the software, technical support, vision and resources of the IDR. An IDR may host varieties of materials depending on the institutional preferences. The actual contents type of an IDR will vary according to its perceived functionality. But a repository must be populated with contents and must be managed in an effective and sustainable way. It is important that policies are put in place which will enable this to happen. The types of contents can range from dissertations and articles, to raw research data and data-sets, post-prints (peer-reviewed research articles), book chapters, working papers theses etc. So it is important for an IDR system to have a stated contents policy keeping in mind the interest of the organization.

Consideration: *What will be the appropriate Contents?*

View of Researcher(s)

One of their (repositories) main characteristics is their great diversity in contents. A group of experts (Gibbons, 2004b; Lynch, 2003; Crow, 2002a; Smith, 2008) describe potential digital contents for the IR. Another expert (Shearer, 2002) reported that MIT's DSpace allows only publisher-accepted materials and the University of California's eScholarship accepts only materials that authors have not submitted to publishers. Not a single repository proposed the possible contents types that they have incorporated into their IDR system. Generally there is no consensus on contents type and different institutions have different contents policy (OpenDOAR, 2012; ROAR, 2012). As per OpenDOAR database (OpenDOAR, 2012), near about 82% repositories have not defined contents policy (Fig. 4.7). This database shows that digital repositories mainly contain textual materials (Fig. 4.8).

Analysis of Roarmap Database

A review of a number of existing repositories shows that institutional policies regarding contents vary substantially and documents are mainly text-based articles of various types though a few IDR little evidence of more complex digital materials, datasets, software, patents etc. (ROARMAP, 2012).

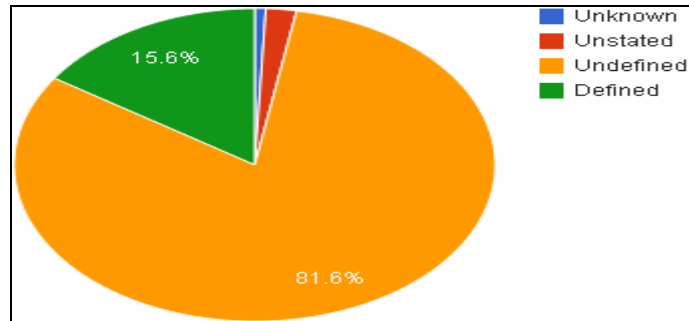


Fig. 4.7: Contents Policies – Worldwide
(Source: OpenDOAR, 2012)

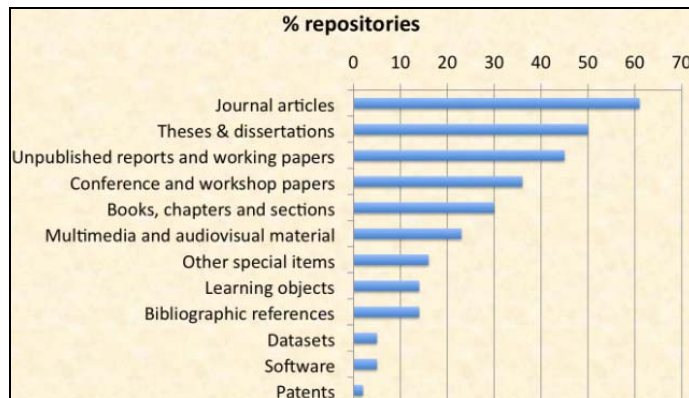


Fig. 4.8: Contents type of Repositories
(Source: OpenDOAR, 2012)

Recommendation(s)

A set of recommendations are drawn to include following documents type as Contents policy for BURA on the basis of the discussion made in this particular section 4.2.1.3 and additional notes are given below²:

²BURA will accept only scholarly, educational or research oriented digital objects produced, submitted or sponsored by members of the University of Burdwan.

³*Contributors* may include outsiders if they are co-authoring with the university authors or are affiliated closely with the University of Burdwan.

1. *Journal articles*
2. *Theses & Dissertations*
3. *Unpublished reports and working papers*
4. *Conference and workshop papers*
5. *Books, chapters and sections*
6. *Multimedia objects*
7. *Learning objects*

4.2.1.3.1 Principal Language

Any repository system is expected to cover several regional/local languages other than default English language. As per the report (Technology Development for Indian Languages Group, 2003), less than 5% people in India can read and write English. So such a system will have far reaching consequences in our country (India) where English is not spoken or understood by the majority of the people living in areas away from urban environments.

Consideration: *Language(s) to be covered*

View of Researcher(s)

To date, the published literature regarding this matter is very limited and no research works has been reported in this area. Study (DINI, 2003) advocated that key word must be in English and abstracts in English and other national languages. Another important database (OpenDOAR, 2012) reported that almost 73% repositories cover only English language (Fig. 4.9).

Analysis of Roormap Database

Most of the IDRs have no official policy and holds several other regional languages. It may be Spanish, German, Japanese, French and so on.



Fig. 4.9: Most Frequent Languages in OpenDOAR - Worldwide
(Source: OpenDOAR, 2012)

Recommendation(s)

A set of recommendations are drawn on the basis of the discussion made in this particular section 4.2.1.3.1:

1. *BURA may cover English, Bengali and Hindi (although other languages will be accepted);*
2. *Metadata may be in English in case language is not English (except Bengali language); and*
3. *English translation of the title and abstract may be provided (except Bengali), if the language is not English, if required.*

4.2.1.4 Copyright and Licensing Policy

This policy is extremely complex and unsettled. Understanding copyright issues is vital to the success of any IDR project. For an IDR system, rights management generally refers to how contents are distributed in accordance with copyright rules and to indicate who owns the copyright for the contents deposited to the IDR or which licensing model is to be followed. Generally an IDR system deals with copyright issues on two fronts: *in collecting contents from researchers*, by which they must secure the rights to distribute and preserve the contents, and *in distributing contents to end users*, by which they must explicitly advertise their data-reuse copyright policies.

Consideration: *Legal copyright holder and Licensing Model*

View of Researcher(s)

Several issues related to this policy are missing and have not been discussed in literature. Studies (Ware, 2004; DINI, 2003) reported that most of the IDRs require the depositing author to grant (non-exclusive) electronic rights to the IDR and to warrant their right to do so. The other experts (Gadd, Oppenheim & Probeta, 2003a; Morgan & Team IDR, 2006; ALPSP, 2002; Kling & McKim, 2000; Bennett, 1999) recommended that copy rights would be owned by the author. Another study (Gadd, Oppenheim & Probeta, 2004; Xia et al., 2012) reported that many institutions ask for copyright-free licenses on items, such as the Creative Commons (CC) non-commercial license.

Analysis of Roarmap Database

Generally in any IDR system, copyright is maintained and managed by license. Anybody can use default license as with the repository software or can use other licenses (i.e. BSD (Berkeley Software Distribution) license, MIT license, Common Public License, Creative Common (CC) License, Apache Software License and so on) or can make their own license. If necessary, it could be modified as per the requirements of the institution. It is found that only nine (9) IDRs have mentioned licensing model (Table 4.5) and stated that author will retain all the rights he/she had before the item was deposited. Almost all the IDRs (except one) are using Creative Common (CC) License (Table 4.5). It is not clear from the IDRs site what licensing model they are using. Generally most of the IDR systems follow the same license as specified by the IDR software (ROAR, 2012; OpenDOAR, 2012; ROARMAP, 2012).

Name of the Repository	Policy related to Copyright and Licensing Model
Universidade Aberta	Creative Commons
California Digital library (CDL)	Creative Commons
Queensland University of Technology	Creative Commons
University of Birmingham Research Archive	Creative Commons
University of Melbourne Eprint Repository	Own
University of Porto	Creative Commons
University of South Australia	Creative Commons
University of Utah's institutional repository	Creative Commons
Wellcome Trust	Creative Commons

Table 4.5: Copyright and Licensing Policy

Recommendation(s)

A set of recommendations are drawn as Copyright and Licensing Policy for BURA on the basis of the discussion made in this particular section 4.2.1.4 and additional note is given below³:

1. *Author will retain the copyright to their work, unless they explicitly give it away to a third party;*
2. *Items deposited in the Repository retain all original Intellectual Property Rights;*
3. *Author will grant a non-exclusive distribution and deposit license to BURA;*

³If an item is submitted to BURA but a restriction is placed on it for a period, only the abstract will be made public while the full text is blocked until the expiration of the embargo period.

4. *BURA prefer to use BSD license as adopted by DSpace (vide section 4.3 of chapter 4) with some modifications, if required;*
5. *License may also be used in the case of multiple authors;*
6. *If research is generated as a result of collaboration between multiple authors, BURA will accept an author signature on behalf of his or her co-author (s) in good faith;*
7. *Depositors or contributors neither can sale article for a profit nor can authorize others to do the same;*
8. *Theses/Dissertation/Project, and other intellectual research works. are subject to the rules and regulations in the Thesis Deposit Agreement as proposed by the University of Burdwan; and*
9. *Where copyright has been assigned to a publisher, a license shall be required from the publisher permitting the work to be available in the Repository.*

4.2.1.5 Data Access Policy

This policy is crucial for the good operation of the repository. A Data policy or user policy states the ways users may use the information they find it in the IDR. Whether repository would impose any access restriction to its contents? If yes, will repository follow different rules and standards for different groups for different types of documents? Will repository provide access only full text or metadata or both? What forms of access for full text records are offered by the repositories? Will access be managed at the institutional/departmental level, user registration level, or at the dataset level? Will registration be compulsory before downloading or accessing data? Will a local registration system be implemented or will it support interoperability with other systems?

Consideration: *Access restriction and Level of access control*

View of Researcher(s)

By default, items should not have any access restrictions. Crow's short definition of institutional repositories says that they should be "...accessible to end users both within and outside of the institution, with few if any barriers to access" (Crow, 2002a). Clearly, most repositories offer OA accessibility. But there may be certain circumstances when control is necessary. University Grants Commission (2005) supports access control to the contents deposited to the repository. Gibbons (2004)

reported that there may be some situations when depositors need to restrict access to items in IDR and it (access control) depends on the types of potential documents. He concluded that where and how access control levels are determined is another feature to consider. Another expert (Johnson, 2002) argued that implementing these policy-based restrictions requires robust access and rights management mechanisms to allow or to restrict access to contents and, conceivably, to parts of digital objects - by a variety of criteria, including user type, institutional affiliation, user community, and others. Another study (Crow, 2002a) advocated limited access to particular contents to a specific set of users. The other study (Green, Macdonald & Rice, 2009) recommended controlling access based upon user type/status (general public, research organization, membership, administrative staff).

Analysis of Roarmap Database

However, a variety of legitimate circumstances might require an institution to limit access to particular contents to a specific set of users. It is found that all IDRs offer some mechanisms by which access to the documents can be controlled. Most of the IDRs support this view and suggest different rules for different collections for different users (Table 4.6).

Consideration: How authentication is to be done

View of Researcher(s)

There is lack of published literature regarding this particular issue. DINI (2003) suggested applying advanced electronic signature for this purpose. As per OpenDOAR (OpenDOAR, 2012) and ROAR (ROAR, 2012) databases, most of the repositories use user name and password for identifying valid user in the system. The other study (Green, Macdonald & Rice, 2009) recommended controlling access based upon Location – access restricted to specific IP (Internet Protocol) location or physical location. Other experts (Hombal & Prasad, 2012) suggested access control by license and encryption methods.

Analysis of Roarmap Database

Generally it is found (Table 4.6) that IP authorization and user authorization (login and password) are the two most common methods of identifying valid users on a system at this time.

Name of the Repository	Policy related to Access Control /Access Pattern
Anglia Ruskin Research Online	<ul style="list-style-type: none"> • File contains confidential or commercially sensitive information; • publisher imposes restrictions on the use of pre- and/or post-prints • Restriction on access for specific items comply with intellectual property or copyright agreements (i.e. publisher embargoes)
Archive ouverte UNIGE	<ul style="list-style-type: none"> • Full text items are available only to community members and may not be distributed to anyone. • Some closed full items may be available only to their authors
Arizona State University Digital Repository	<ul style="list-style-type: none"> • Access restrictions must be defined when an item or collection is submitted. • Follows three levels of access (i.e. all users can access the work (default); all users can access the work after a designated embargo period; requests for limited, campus-only access on a case by case basis)
Aston University Research Archive	<ul style="list-style-type: none"> • Restriction on access to works, whether in part or in full comply with intellectual property or copyright agreements (i.e. publisher embargoes)
Brandeis Institutional Repository	<ul style="list-style-type: none"> • For special circumstances, arrangements can be made to place a temporary embargo on distribution or to restrict access within the community
California Institute of Technology	<ul style="list-style-type: none"> • Restriction on access to full text for specific cases for specific items for a certain period • Licensing agreements with publishers or pending patents. Each file can have its access level independently set • Follows three type of access (i.e. Anyone; Caltech Users Only; Repository Administrators Only)
Concordia University Research Repository	<ul style="list-style-type: none"> • In some cases, access to content may be limited to the community members only • Restriction on access to the community members on special circumstances
Cornell University Library	<ul style="list-style-type: none"> • Access to the full text may be restricted to members of the community
Goddard Library Repository	<ul style="list-style-type: none"> • Handle a variety of access restrictions
Illinois Digital Environment for Access to Learning and Scholarship	<ul style="list-style-type: none"> • Access restrictions to be imposed at the collection or item level comply with intellectual property or copyright agreements (i.e. publisher embargoes)
Massachusetts Institute of Technology (MIT)	<ul style="list-style-type: none"> • Limit access to content at the item level either to members only or to specific individuals or groups
Natural Environmental Research Council	<ul style="list-style-type: none"> • Access to some full text items are controlled
University of Abertay Dundee	<ul style="list-style-type: none"> • Some material is reserved for internal use and accessible to staff only • Embargoed items are withheld from public view
University of Hawaii at Manoa	<ul style="list-style-type: none"> • Restrict or limit access to content at the item level
University of Kansas	<ul style="list-style-type: none"> • Restriction on access to groups of registered users at the item, collection, or community level • Communities are responsible for establishing access control policies for content in their collections

Name of the Repository	Policy related to Access Control /Access Pattern
University of North Texas	<ul style="list-style-type: none"> Follows three levels of access (i.e. open access to the public; limited access in either time or to specific groups; closed, no Access)
University of Pittsburgh	<ul style="list-style-type: none"> Restriction of access to community members for an optional embargo period
University of Rochesters	<ul style="list-style-type: none"> Restriction on access at the file level, not just deposit level
University of Southampton Research Repository	<ul style="list-style-type: none"> Full items are available only to members
University of Sydney	<ul style="list-style-type: none"> Restriction on access at the community level
Victoria University Institutional Repository	<ul style="list-style-type: none"> Restriction on access to full text for specific cases for specific items

Table 4.6: Data Access Policy

Recommendation(s)

A set of recommendations are drawn as Data Access Policy for BURA on the basis of the discussion made in this particular section 4.2.1.5 and additional note is given below⁴:

1. *Follow different access policies for different collections or for different types of contents (read, remove, add, write);*
2. *Follow different access rules for different groups or users (students, research scholar, faculty, local, distant etc.);*
3. *Allow access restrictions to be imposed at the collection or item level as it depends on the types of documents. Communities are responsible for establishing access control policies for contents in their collections;*
4. *Authentication is to be done by requesting user name and password of registered users; and*
5. *In case of exact published version the article may be made publicly accessible only after embargo period has expired (section 4.2.1.6). It (articles) may be deposited any times, but no access would be allowed in this period. Abstract may be available in this period.*

⁴If the work is published in a journal, BURA Administrator will check the SHERPA/RoMEO database (<http://www.sherpa.ac.uk/romeo/>) to ensure that files submitted to BURA follow publishers' rules regarding copyright and inclusion in an IR.

4.2.1.6 Embargo Policy

The embargo period or retention period is another aspect to consider. Some conditions may be imposed upon author by publishers or funding bodies. Different publishers have different policies relating to preprints and post prints of journal articles. Publishers may request embargo periods before the end of which a published work may not be made openly available in the repository. Different funding bodies have different requirements for outputs from work they have funded. Some theses and other works may also have embargo periods. These policies will need to be related to copyright and other rights management as they will form parts of legal contracts with other organizations or individuals.

Consideration: Embargo period

View of Researcher(s)

Some repository infrastructure systems have the technical capacity to embargo or sequester access to data until the contents has been approved for release to the public (Green, Macdonald & Rice, 2009). Although a few repositories suggest depositing six (6) months after publication, others encourage depositing at the time of publication, upon institutional request, or after a publisher's embargo period (typically six-months following publication) (Xia et al., 2012). The most common length of time for an embargo period is six (6) months, although some publishers will insist upon one year (Sale, 2006b). Another UK funding world's largest private funder of medical research (Wellcome Trust Position Statement, 2003-2004) recommends six (6) month as an embargo period. The period varies considerably from publisher to publisher and discipline to discipline. It may be as short as three (3) months for some science journals or as long as 24 months in the humanities and social sciences (OpenAIRE, 2011). In science, publisher embargoes are normally 6-12 months though most funder policies currently do allow short embargo periods six (6) months (Swan, 2012). Suber (2009) is in support and concluded that all medical funders except the NIH use a 12 month embargo whereas European Research Council currently uses a six month embargo. Many publishers – but certainly not all – stipulate an embargo period before an article can be made OA and it is found that most of the publishers follow 6-12 months as embargo period and most of the articles are deposited with in this period (SHERPA/RoMEO, 2011). Some publishers allow self-archiving of the final version of an article but require an embargo period during which OA is not allowed. It is found that 66% of publishers on this list formally allow some form of self-archiving (SHERPA/RoMEO, 2011).

Analysis of Roarmap Database

Most of the IDRs have no official policy. Only a few IDRs have mentioned embargo period. Many suggested 6 months, many no delay periods at all, and a few suggested 3 months as embargo period (Table 4.7).

Name of the Repository	Policy related to Embargo Period
Anglia Ruskin Research Online	within two years (in case of thesis)
Arthritis Research	not later than 6 months after publication
Australian Research Council	within 6 month after project completion
British Heart Foundation	within 6 months after publication
California Polytechnic State University	within 1-year after publication
Canadian Institutes of Health Research	within 6 months after publication
Canadian Breast Cancer Research Alliance	within 6 months after publication
Canadian Cancer Society	not later than 6 months after publication
Canadian Health Services Research Foundation	within 6 months after publication
Chalmers University of Technology	within 6 - 12 months after publication
Chief Scientist Office	within 6 months after publication
Department of Health	within 6 months after publication
Duke University	within 6 months to 2 years after publication
Dunhill Medical Trust	within 6 months after publication
European Commission	within 12 months after publication
European Heads of Research Councils	within 6 months after publication
European Research Advisory Board	Author-requested embargo, or 6 months, whichever comes first
European Research Council	within 6 months after publication
European University Association	within 6 months after publication
Fonds de la recherche en sante Quebec	not later than 6 months after publication
Genome Canada	within 6 months after publication
Institute of Education Sciences	not later than 12 months after publication
Joint Information Systems Committee	within 6 months after publication
Madrid Autonomous Community of Spain	6 months for Technology & Biosciences & 12 months for Social Sciences & Humanities
Medical Research Council	within 6 months after publication
Michael Smith Foundation for Health Research	within 6 months after publication
National Institutes of Health	not later than 12 months after publication
San Jose State University	within 6 months after publication
United States Department of Agriculture	within 3 months after publication
University of Abertay Dundee	within 3 months after publication
University of Barcelona	not exceeding 6 months after publication
University of Helsinki	after stipulated by the publisher or the funding body
University of Maryland	within 1- 6 years after publication
University of Surrey	not later than 6 months after publication
University of Tasmania	within 6 months after publication
Wellcome Trust	not later than 6 months after publication

Table 4.7: Embargo Policy

Recommendation(s)

A set of recommendations are drawn as Embargo Policy for BURA on the basis of the discussion made in this particular section 4.2.1.6:

1. *Embargo period has been fixed up by 6 month;*
2. *Embargo period may be fixed irrespective of disciplines; and*
3. *Articles will be made publicly accessible only after embargo period has expired.*

4.2.1.7 Metadata Policy

In the metadata policy the questions arise who can enter or edit metadata or which metadata standards are to be followed? Will we follow different metadata schema for different type of documents? Or will the repository follow any indexing systems? Will the repository system allow metadata harvesting of dataset descriptions by other institutions following the OAI-PMH guidelines, or other harvesting protocols?

Consideration: *Metadata policy defined*

View of Researcher(s)

As per OpenDOAR (OpenDOAR, 2012) database, more than 84% repositories have not defined metadata policy (Fig. 4.10). So it is important for any IDR system to have a metadata policy. Several issues (e.g. will metadata of withdrawn items be searchable?) related to this policy have not been considered and are missing in the literature.

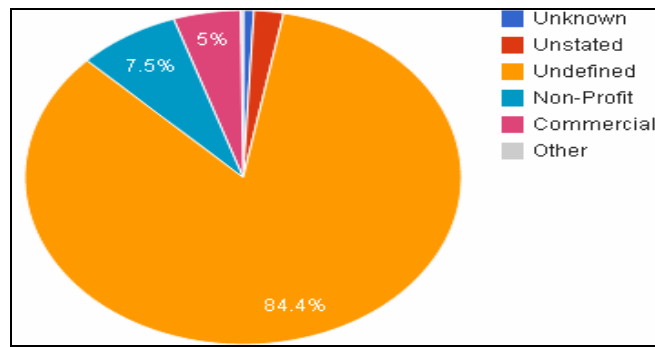


Fig. 4.10: Metadata Policy
(Source: OpenDOAR, 2012)

Analysis of Roarmap Database

As per the database most of the IDRs have no metadata policy and several issues are missing. But almost all the IDRs clearly stated that anyone may access the metadata free of charge. Some metadata may be restricted based on the requirements of the collection.

Consideration: Who can enter or edit metadata

View of Researcher(s)

Good quality metadata is extremely important to support a level of service that enables contents to be found quickly and easily. Only a few studies (Graaf & Eijndhoven, 2008; Barton & Walker, 2002) suggest academics to enter simple metadata, such as author name, title and keywords, or have a mediated service where the administrator adds the metadata. So it may be better to either get academics to enter simple metadata, such as author name, title and keywords, or have a mediated service where the administrator adds metadata. Another study (DINI, 2003; Pinfield, Gardner & MacColl, 2002; University Grants Commission, 2005) advocated that standardized metadata should be created and provided for exchange and harvesting services.

Analysis of Roarmap Database

Only a few IDRs (Table 4.8) have suggested that metadata should be created and provided by author or eligible contributors. Library staff, if necessary, may edit or create additional metadata.

Consideration: Metadata Standards to be used

View of Researcher(s)

Many researchers (Green, Macdonald & Rice, 2009) reported that IDR systems differ widely in the handling of metadata schema and repositories may need to put in place additional metadata schemas to support the ingest, management, and use of data in their collections. Another study (Graaf & Eijndhoven, 2008) concluded that most of the digital repositories follow the qualified Dublin Core standards and unqualified Dublin Core standards. University Grants Commission (2005) supports this view and also suggests using other metadata schema to meet the needs of users and to provide better access and management of different type of digital objects. Another expert (Gibbons, 2004) reported that a few IDRs have created their own metadata schemas, and others have used or adapted existing schemas, such as Dublin Core or MARC. In

some systems, the metadata schema is hard-coded, and others support some degree of modification. Some IDRs can provide for a different metadata schema with each collection, and others require the same metadata schema across the entire repository. The other study (DINI, 2003) reported that some IDRs are starting to support some other metadata standards (such as Onix).

Analysis of Roarmap database

It is also clear from the study that almost all the IDRs use Dublin Core standards. A few repositories implemented additional or extended metadata schemas for domain specific datasets (Table 4.8).

Consideration: Indexing systems to be used

View of Researcher(s)

To date, the published information about this study is limited. Few studies (DINI, 2003; Nolan & Costanza, 2006; University Grants Commission, 2005) recommend that standard vocabularies should be followed.

Analysis of Roarmap Database

Only two (2) IDRs (Kwame Nkrumah University of Science and Technology Institutional Repository & University of Abertay Dundee) have suggested that controlled vocabularies should be followed (Table 4.8).

Consideration: Metadata harvesting from OAI-PMH compliant repositories

View of Researcher(s)

Only a few studies (Hirwade & Hirwade, 2006; Singh, Pandita & Dash, 2008) have discussed this issue and focused on the present situation in India. Another research study (Sarkar & Mukhopadhyay, 2010) proposed a harvesting model (for e-theses) using PKP harvester and explained how metadata is extracted from different OAI-PMH compliant repositories.

Analysis of Roarmap Database

Not a single repository has any published documentations. Only a few repositories, in principal, support metadata harvesting from OAI-PMH compliant repositories. But practically no such framework based on global standards has been developed.

Name of the Repository	Policy related to Metadata		
	Metadata Schema Used	Bibliographic Metadata	
		Provided by	Created or Edited by
Anglia Ruskin Research Online Brandeis Institutional Repository	Simple Dublin Core	Eligible contributor	Library staff
Brigham Young University Library Centre for Environmental Data Archival Repository Cornell University (eCommons) Edith Cowan University	Simple Dublin Core	√	Library staff
Goddard Library Repository Griffith University Harvard University Library	Unqualified Dublin Core GEMS (own)	√ authorized submitter	
Katholieke Universiteit Leuven Kwame Nkrumah University of Science and Technology Institutional Repository (KNUSTSpace) Loughborough University Massachusetts Institute of Technology (MIT)	Qualified Dublin core	√ Eligible contributor/ depositors	√
Northeastern University Libraries Institutional Repository	METS schema & Qualified & unqualified Dublin Core (descriptive metadata)	√	
St John University Teesside University's Institutional Repository (TeesRep) Trento University University of Abertay Dundee	Dublin Core	√ Authors/ or delegated agents	√
University of Calgary: Library and Cultural Resources University of Cambridge	Qualified Dublin Core	√	
University of East Anglia University of Kansas	Dublin Core Library Application Profile (DC-Lib)	√	
University of Melbourne Eprint Repository University of Queensland University of Reading University of Rochester's	Simple Dunlin Core Dublin Core & locally defined DTDs	√ √	

Name of the Repository	Policy related to Metadata	
	Metadata Schema Used	Bibliographic Metadata Provided by Created or Edited by
University of Salford	Dublin Core	√
University of South Australia	MARXML & DC	
University of Starling (STORRE)	Dublin Core	
University of Sydney	Qualified Dublin Core	
University of Utah's institutional repository	Dublin Core	
University of Westminster		√
York St John University		√

Table 4.8: Metadata Policy

Recommendation(s)

A set of recommendations are drawn as Metadata Policy for BURA on the basis of the discussion made in this particular section 4.2.1.7:

1. *Anyone may access the metadata free of charge;*
2. *All metadata in the repository should be based on the recognized global standard;*
3. *Qualified version of the Dublin Core schema as a descriptive metadata standard will be used;*
4. *Community/domain-specific metadata elements will be used where no suitable element or element refinement exists;*
5. *Recommends DCMES as generic metadata schema and suggests respective domain-specific schemas for special objects like ETD (ETD-MS), Learning Objects (IEEE-LOM), Journal articles (ONIX) etc. on the basis of a set of standard parameters;*
6. *Deposit of materials to BURA requires a minimum set of descriptive information (metadata) to be provided at the point of deposit;*
7. *Basic metadata will be created by authors or their delegated agents at the time of submission;*

8. *Library staff will create additional metadata elements and edit basic metadata set, if required, to ensure the quality of complete metadata records;*
9. *Recommends following basic cataloging standards –AACR/RDA – for personal and corporate names;*
10. *BURA may provide metadata harvesting service and supports metadata extraction from OAI-PMH compatible repositories;*
11. *Indexing systems supporting advanced set of search operators (including Fuzzy searching) based on international standards will be followed;*
12. *Controlled vocabularies will be used to maintain consistency and to enhance the quality of records exposed to search and browse services; and*
13. *The metadata of withdrawn items shall not be searchable.*

4.2.1.7.1 Metadata Re-use Policy

This policy is concerned with re-use of metadata. May the metadata be reused in another medium without prior permission provided there is a link to the original metadata and/or the repository is mentioned? Will it be permissible to reuse the metadata for commercial purposes? Is formal permission required?

Consideration: Re-use of Metadata

View of Researcher(s)

To date, the published information about these studies is limited. There is no published literature on this issue related to this policy. There is no research work has been reported in the literature. No expressive study has been carried out in this particular area.

Analysis of Roarmap Database

Only a few IDRs have Metadata Re-use Policy (Table 4.9) and have stated that the metadata may be re-used in any medium without prior permission for not-for-profit purposes and the metadata must not be re-used in any medium for commercial purposes without formal permission.

Name of the Repository	Metadata may be re-used in any medium without prior permission	Metadata must not be re-used in any medium for
Arts and Humanities Research Council	for not-for-profit purposes	commercial purposes without formal permission
Aston University Research Archive	√	√
Canadian Cancer Society	√	√
Canadian Health Services Research Foundation	√	√
Canadian Institutes of Health Research	√	√
Centre for Environmental Data Archival Repository	√	√
Covenant University	√	√
Curtin University	√	√
Edith Cowan University	√	√
European Heads of Research Councils	√	√
European Research Advisory Board	√	√
European Research Council	√	√
European University Association	√	√
Fonds de la recherche en sante Québec	√	√
Fonds zur Foerderung der wissenschaftlichen Forschung	√	√
Goddard Library Repository	√ (Unrestricted metadata)	
Genome Canada	for not-for-profit purposes	√
Heart and Stroke Foundation of Canada	√	√
JISC (Joint Information Systems Committee)	√	√
Katholieke Universiteit Leuven	√	√
Khazar University	√	√
Kwame Nkrumah University of Science and Technology Institutional Repository (KNUSTSpace)	√	√
Leeds Metropolitan University	√	√
Loughborough University	√	√
Michael Smith Foundation for Health Research	√	√
Murdoch University	√	√
National Research Council	commercial purposes without formal permission	√
Natural Environmental Research Council	for not-for-profit purposes	√
Natural Sciences and Engineering Research Council of Canada	√	√
Northern Melbourne Institute of TAFE	√	√
Ontario Institute for Cancer Research	√	√
Queensland University of Technology	√	√
St John University	√	√
Stanford University: School of Education	√	√
University of Strathclyde Institutional Repository (Strathprints)	√	√

Name of the Repository	Metadata may be re-used in any medium without prior permission	Metadata must not be re-used in any medium for
Teesside University's Institutional Repository (TeesRep)	√	√
Trento University	√	√
Universidad Nacional de Colombia	√	
University of Bath	√	√
University of East Anglia	√	√
University of Calgary: Library and Cultural Resources	√	√
University of Edinburgh	√	√
University of Leicester	√	√
University of Lincoln	√	√
University of of Melbourne Digital Repository	√	√
University of Nottingham	√	√
University of Reading	√	√
University of Salford	√	
University of Surrey	√	√
University of Southampton Research Repository (ePrints Soton)	√	√
University of Virginia	√	√
University of Wollongong	√	
Warwick Research Archive Portal	√	√
York St John University	√	√

Table 4.9: Metadata Re-use Policy

Recommendation(s)

A set of recommendations are drawn as Metadata Re-use Policy for BURA on the basis of the discussion made in this particular section 4.2.1.7.1:

1. *The metadata may be re-used in any medium without prior permission for not-for-profit purposes; and*
2. *The metadata must not be re-used in any medium for commercial purposes without formal permission.*

4.2.1.8 Multilingual Policy

With the recent rapid diffusion over the international computer networks of world-wide distributed document bases, the question of multilingual access and multilingual information retrieval is becoming increasingly relevant. Multilingual digital libraries are gaining momentum in most of the developing countries. One of the major responsibilities of these multilingual digital libraries is to support multilingualism. So far, in the Digital Library (DL) sector, most research and development activities have concentrated on monolingual environments and, in the large majority of the cases, the language employed has been English. India has 418 languages of which 407 are living and 11 are extinct (Maitra, 2002) and less than 5% people can read and write English (Technology Development for Indian Languages Group, 2003). India is considered as a multilingual country having twenty-two (22) constitutionally recognized Languages and other regional languages with many variations of dialects; so development of regional/local language based interfaces as well as Indic-script based Unicode-compliant processing and retrieval environment are mandatory for Indian IDRs. And, multilingual document processing and retrieval environment should be a mandatory parameter for BURA.

Consideration: Designing Unicode-compliant Indic-script based interface

View of Researcher(s)

To date, the published information on this area is limited. No expressive study has been conducted in this area. This policy has not been properly discussed in literature and several issues related to technical interoperability are missing.

Only a few researchers (Das et al., 2005; Mukhopadhyay & Azim, 2006; Mukhopadhyay, 2007) developed Bengali script based digital library systems through the application of open standards and OSS. In another paper (Mukhopadhyay, 2006a, 2006b), author demonstrates designing FLOSS Floss based software framework for public library based and Web-enabled multilingual community information service. It is found that out of 2165 (as on 19/06/2012) IDRs, near about 1562 IDRs (72.14%) cover English documents (OpenDOAR, 2012). In case of India, it is, out of 70 IDRs, only 9 (nine). It covers Sanskrit, Hindi, Urdu, Gujarati, Malayalam, and Kannada.

Analysis of Roormap Database

This issue has been neglected by most of the repositories and research/funder organizations. Only a few IDRs have provision to incorporate multilingual documents into their system and support searching and browsing of multilingual objects. It is also true in case of India. Only a few IDRs have this provision.

Recommendation(s)

A set of recommendations are drawn as Multilingual Policy for BURA on the basis of the discussion made in this particular section 4.2.1.8:

A university-specific IDR system is expected to cover all the languages taught in the university. So in our case there should have a provision to incorporate documents in Bengali and Hindi languages other than English in BURA along with user interfaces for selected languages/scripts. For example, this research work has developed mechanism to switch user interfaces from English to Bengali and/or Hindi as per the requirement of users (Fig. 4.11 & Fig. 4.12).

বর্ধমান বিশ্ববিদ্যালয় গবেষণা সংগ্রহ [সম্প্রদায়ের তালিকা](#)

বর্ধমান বিশ্ববিদ্যালয় গবেষণা সংগ্রহ

বর্ধমান বিশ্ববিদ্যালয় গবেষণা সংগ্রহশালার নতুন ইন্টারফেসে (ম্যানাকিন) আপনাদের স্বাগত জানাই। এই ডিজিটাল ভান্ডার পদ্ধতিটি বিশ্ববিদ্যালয়ের গবেষণা সংক্রান্ত দ্রব্যসামগ্রী নিয়ন্ত্রণ, সঞ্চয়, পরস্পর সজ্জাকরন, সংরক্ষন এবং বিতরণ করে। এই সংরক্ষন পদ্ধতি বিশ্ববিদ্যালয়ের প্রদত্ত জ্ঞান-ভাণ্ডার এবং গবেষণা সংক্রান্ত তথ্যাদি সংরক্ষন করে; পাণ্ডিত্যপূর্ণ যোগাযোগ করতে সাহায্য করে।

গবেষণা সংগ্রহ তালিকা

একটি সম্প্রদায়ের অন্তর্ভুক্ত সংগ্রহের মধ্যে খুঁজুন।

- [Faculty of Arts and Humanities](#)
- [Faculty of Infrastructural Facilities](#)
- [Faculty of Science](#)

গবেষণাগারে অনুসন্ধান করুন

অনুসন্ধানের জন্য নিম্নের বক্সের মধ্যে কিছু পাঠ্য লিখুন।

অনুসন্ধান করুন

[বিস্তৃত অনুসন্ধান](#)

খুঁজুন

- **সমন্বিত ডিস্কপেস**
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 - [বিষয়গুলি](#)

আমার খাতা

- [লগ-ইন](#)
- [নথীভুক্তকরন](#)

Fig. 4.11: Multilingual User Interface

Fig. 4.12: Advanced Search Interface in Bengali

4.2.1.9 Preservation Policy

The preservation policy indicates how long contents will be retained in the IDR, whether items will be migrated to new file formats, if the repository will ensure the continued readability and usability of its contents (dealing with software and hardware obsolescence), or who will take back up and if there will be a backup strategy in place. What systems are to be put in place to ensure that contents is preserved for the long term? Will some types of contents be prioritized over others for preservation? Will data files be migrated to new file formats where necessary to preserve access to their intellectual contents? In the event of the repository being closed down, will the data be transferred to another appropriate archive? Will the repository regularly back up its files according to current best practice?

Consideration: *Availability of resources and appropriate technique*

View of Researcher(s)

To date, most of the repositories have no formal preservation policy, except of the recommendation of file formats that are likely to facilitate long-term preservation. This section deals with how the repository will manage datasets over time. As per

OpenDOAR (OpenDOAR, 2012) database, most of the repositories have no such preservation policy. Only 7.7% repositories have defined this policy but several technical and non-technical issues are missing and have not stated clearly in the literature (Fig. 4.13). Studies (Jones, Andrew & MacColl, 2006; Lynch, 2003) clearly stated that items will be retained indefinitely and one of the definitions of IR supports this view (Crow, 2002b). At the same time long term availability of resources has to be ensured (DINI, 2003). It is also found that some institutions provide a fixed term such as 10 years, and others will retain contents in the IR in perpetuity. A few other studies (Smith, 2002; Granger, 2000; Wheatley, 2001; Han, 2004) suggested preservation of digital objects using different techniques through software.

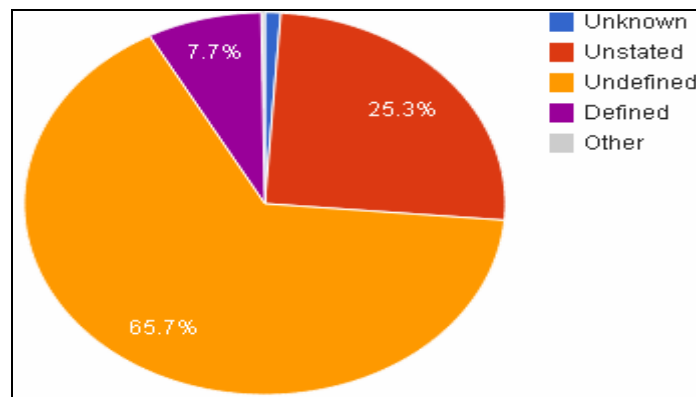


Fig. 4.13: Preservation Policy
(Source: OpenDOAR, 2012)

Analysis of Roarmap Database

Generally the normal practice is to retain the current, previous, and original versions of the files as most of the IDRs support this view (Table 4.10). Several IDRs recommend that migration to new formats will be carried out and software emulations will be provided to access materials that could not be migrated. In order to ensure long-term preservation, items will be migrated to new file formats and/or new generation computers where necessary, thus maintaining the integrity of the digital file. But the original bit stream is retained for all items, in addition to any upgraded formats. Even the repository will keep regularly backs up its files according to current best practice. Administrator may keep more than one copy of this submission for purposes of security, back-up and preservation. Below are the explanations on the basis of which the following table (4.10) has been prepared.

A = migrated to new file formats where necessary; B = software emulations will be provided to access un-migrated formats; C = backs up its files according to current best practice; D = transfer the database to another appropriate archive

Name of the Repository	Policy related to Preservation		
	Retention Period	Functional Preservation	File Preservation
Anglia Ruskin Research Online	Items will be retained indefinitely	<ul style="list-style-type: none"> migrated to new file formats where necessary software emulations will be provided to access un-migrated formats 	<ul style="list-style-type: none"> backs up its files according to current best practice transfer the database to another appropriate archive
Archive ouverte UNIGE	√	A	C & D
Arts and Humanities Research Council	√		C & D
Aston University Research Archive	√	A	C & D
Bond University	√	A	
Canadian Health Services Research Foundation	√		C & D
Canadian Institutes of Health Research	√		C & D
California Digital Library (CDL)		A	
Canadian Cancer Society	√		C & D
Centre for Environmental Data Archival Repository	√	A	C & D
Concordia University Research Repository		A (recommended formats for preservation & access)	
Covenant University Repository	√	A & B (un-migrated formats)	C & D
Cornell University Library		A (submission in a recommended file format is strongly encouraged)	
Council of Scientific and Industrial Research, India	√	B (for old file formats)	C & D
Edith Cowan University	√	A	C & D
European Heads of Research Councils	√		C & D
European Research Advisory Board	√		C & D
European Research Council	√		C & D
European University Association	√		C & D
Fonds de la recherche en sante Quebec	√		C & D
Fonds zur Foerderung der wissenschaftlichen Forschung	√		C & D
Genome Canada	√		C & D

Name of the Repository	Policy related to Preservation		
	Retention Period	Functional Preservation	File Preservation
Griffith University	√	A	
Heart and Stroke Foundation of Canada	√		C & D
HKUST Institutional Repository	√	A	C & D
Joint Information Systems Committee	√		C & D
Katholieke Universiteit Leuven	√		C & D
Khazar University	√		C & D
Kwame Nkrumah University of Science and Technology Institutional Repository (KNUSTSpace)	√	A & B	C (Library IT personnel in collaboration with the IT staff)
Leeds Metropolitan University institutional repository	√	A & B	C & D
Leicester Research Archive	√	A	C & D
Loughborough University	√		C & D
Massachusetts Institute of Technology (MIT)	√	A & B	
Michael Smith Foundation for Health Research	√		C & D
Natural Environmental Research Council	√		C & D
National Research Council	√		C & D
Natural Sciences and Engineering Research Council of Canada	√		C & D
Northern Melbourne Institute of TAFE	√	A	C & D
Ontario Institute for Cancer Research	√		C & D
Penn's Institutional Repository		A (obsolescence of current technologies make it necessary to do so).	
Stanford University (School of Education)	√		C & D
Teesside University's Institutional Repository (TeesRep)	√	A & B	C & D
Trento University	√		C
University of Abertay Dundee	√		C & D
University of Bath	√		D
University of Bradford			IT services (back up)

Name of the Repository	Policy related to Preservation		
	Retention Period	Functional Preservation	File Preservation
University of Calgary: Library and Cultural Resources	√	A (Migrate items if format is in danger of obsolescence)	C & D
University of East Anglia	Full-text and metadata will be retained indefinitely	A & B	C & D
University of Edinburgh	Items will be retained indefinitely	A	C & D
University of Florida Institutional Repository			C & D
University of Kansas			C
University of Lincoln	√	A	C & D
Universidad Nacional de Colombia	√	A	D
University of Nottingham	√	A & B	C & D
University of Pittsburgh	√		C
University of Reading	√		C & D
University of Salford	√	A	C & D
University of Starling (STORRE)	√	A & B (bit preservation & functional preservation)	C & D
University of Strathclyde Institutional Repository (Strathprints)	√		C & D
University of Surrey	√		C & D
University of Virginia	√		C & D
University of Westminster			C
Warwick Research Archive Portal	√	A & B	C & D
York St John University	√	A	C

Table 4.10: Preservation Policy

Recommendation(s)

A set of recommendations are drawn as Preservation Policy for BURA on the basis of the discussion made in this particular section 4.2.1.9:

1. *Items will be retained indefinitely to BURA;*
2. *Items may be migrated to new file formats (preferably open formats) where necessary;*

3. *Storing objects in formats that can be migrated as per latest technology;*
4. *Software emulations will be provided to access un-migrated formats;*
5. *Repositories may keep more than one copy of this submission for purposes of security, back-up and preservation;*
6. *Repository will take regularly backs up its files according to current best practice; and*
7. *Repository being closed down, the database will be transferred to another appropriate archive.*

4.2.1.10 File Format Policy

In this policy it should be clear what file formats will be accepted for preservation in the repository (word.doc, adobe. PDF, etc). There are clear differences between file formats because a file format that is good for access today may not be a format that is easy to migrate. On the other hand, a format that is easy to migrate may not be easy to read.

Consideration: *What will be the appropriate format(s)?*

View of Researcher(s)

The first step in defining a preservation strategy is to identify the file formats of the information objects in the repository. Formats should be searchable, open, and appropriate for long-term preservation and intelligent exploitation of the contents. When making decisions about preserving file formats, Jones, Andrew & MacColl (2006) suggest IR staff answer these questions: Is the file format an open standard/format? Is the file format widely used? Is the file format and associated technology likely to be preserved?

In some cases the repository will accept any format, but it won't necessarily guarantee continued access and preservation of obsolete or obscure formats (Green, Macdonald & Rice, 2009). The ARL-sponsored survey reports that 74% of ARL libraries' operational IRs accepts any digital file type. "Relatively few (26%) are committed to functional preservation of every file type" (Bailey et al.,2006a).

Generally all IRs accept PDF format. Those only accepting PDF often offered tools to convert other formats (e.g. Word) into PDF (Ware, 2004). Study reports that most of

the repositories provide ongoing support for as many open file formats (e.g. PDF/A, ODF, TXT, HTML, TEX) as possible with the institutional resources that are available (Crow, 2002a; DINI, 2003). Another study (University Grants Commission, 2005; Sawant, 2012b) reported that the default formats accepted by most IR software are PDF, Postscript, ASCII, and HTML. The other studies (Curtis, 2006; James et al., 2003; Weenink, Waaijers & Godtsenhoven, 2007; Morgan & Team IDR, 2006) suggested different file format for different types of digital objects. Another group of experts (Aschenbrenner & Kaiser, 2005; Pinfield, 2002; Cervone, 2004) concluded that PDF as preferred format for preservation. But Jones, Andrew & MacColl (2006) concluded that the best sort of files are those where the contents and format are human readable. Another study (MIT Libraries, 2002) reported that most of the IDRs allow migration and preserve into suitable format based on the latest technology for access and preservation purpose, using a combination of time-honored techniques for data management and best practices for digital preservation.

Analysis of Roormap Database

From a policy standpoint of preservation, identifying file formats for which IRs provide long-term preservation is necessary, although no consensus on best practices exists. It is found that some IDR systems are format-neutral—the system accepts deposits of any digital format and other systems are hard-coded to only accept formats of certain types. Generally most of the repositories accept many electronic file formats. Certain formats, however, such as plain text, XML, HTML and PDF/A, are recommended because the likelihood of their full preservation in the future is much higher than the others. The IRs accepts all sustainable digital formats and strives to preserve access to the contents. It is found that PDF, ASCII, HTML, and word processed documents are the most commonly used format of any IDR system.

Recommendation(s)

A set of recommendations are drawn as File Format Policy on the basis of the discussion made in this particular section 4.2.1.10:

1. *Everything put in BURA will be retrievable;*
2. *BURA will recognize as many files formats as possible;*
3. *BURA will support as many known files formats as possible; and*
4. *BURA will support open formats as far as feasible.*

4.2.1.11 Quality Control Policy

There is no obvious mention of quality control procedures in the IDRs' documentation. Naturally questions arise how is quality control going to be managed? How will quality be defined and who will oversee the maintenance of standards?

Consideration: Who will check the Contents' quality?

View of Researcher(s)

The repository or individual institution is responsible for the quality of storage and availability of the data (Green, Macdonald & Rice, 2009; Probets & Jenkins, 2006; Genoni, 2004). Another study (Wang & Wang, 2012) recommended that it should be checked by experts and colleagues in the field whereas other study (<http://www.lib.unimelb.edu.au/eprints/collectionpolicy.htm>) recommended that it should be reviewed from the Dean or Head of Department. Several other authors (Genoni, 2004; Allard, Mack & Feltner-Reichert, 2005) stated that this verification is to be done by the librarian at the different stages of submissions process. Day (2003) suggested that the choice being left to those who develop their collection policies.

Analysis of Roarmap Database

To date, the published information about this study is very limited and this issue has been neglected by most of the IDRs and research/funder organizations. Not a single IDR mentions who will check the contents of submitted objects. In most cases, data producers are responsible for the quality of the digital research data.

Consideration: Quality Control Mechanism

This issue has not been discussed properly in the literature. Only a few experts (Pinfield & James, 2003; Probets & Jenkins, 2006; SPARC, 2002b) suggested different quality control mechanism like labeling or differentiating pre- and post-prints into two sections or into separate repositories.

Analysis of Roarmap Database

In this policy, only four (4) IDRs have provided some valuable directions as how it (quality) will be controlled. The other IDRs have no policy. It is also suggested that the issue should be handled at the community or collection level (Table 4.11).

Name of the Repository	Policy related to Quality Control
University of Glasgow University of Salford University of Melbourne Eprint Repository	<ul style="list-style-type: none"> • pre- and post-prints into separate repositories • staff will review and assess all submissions • membership based on education, experience and other qualifications. • working papers review from the Dean or Head of Department • divide the repository into two sections, that of preprint and post-print.
Illinois Digital Environment for Access to Learning and Scholarship	<ul style="list-style-type: none"> • handled at the community or collection level

Table 4.11: Quality Control Policy

Recommendation(s)

A set of recommendations are drawn as Quality Control Policy on the basis of the discussion made in this particular section 4.2.1.11:

1. *Quality control is to be handled at the community or collection level or at different stages of the process, according to the kind of materials to be introduced.*
2. *Materials in the repository are to be reviewed by the university's research faculty or by the subject expert or by library staff specified for this task.*
3. *In case of non-peer view articles or pre-prints or working papers, it should be recommended by the Head or Dean keeping in mind the reputation of an organization or department as it is a likely indicator of the quality of the research manuscripts it publishes.*
4. *Materials written by students or research scholars be co-author and recommended by his guide, supervisor, Head of the department as all research-based work does not mean that it is of a high quality; and*
5. *Library staff will only review and enhance metadata but will not check or alter the contents of items.*

4.2.1.12 Submission Policy

Major policy decisions will be needed related to this submission policy. In this policy it is important to define who will be able to submit contents. A very important decision in the submission policy is whether or not your institution will provide any assistance with the submissions. And if you will mediate the submissions, how far will you go? Or what is the workflow for submission?

Consideration: *Eligible Submitter and providing assistance to submission*

View of Researcher(s)

Several issues relating to this submission policy have not been discussed in literature. As per OpenDOAR (OpenDOAR, 2012) database, 80% repositories have not defined submission policy (Fig. 4.14). Generally, registered user/authorized user can only submit objects to the IDR. Only a few researchers (Horwood et al., 2004; Ashworth, Mackie & Nixon, 2004) suggested using a system of ‘*mediated deposit*’ to assist the contributors in submission process. The other points are missing and remain unsolved.

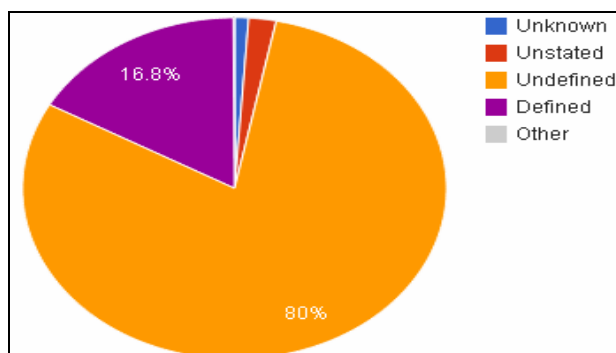


Fig. 4.14: Submission Policy
(Source: OpenDOAR, 2012)

Analysis of Roarmap Database

It is found that most of the IDRs allows author to archive their items and the authority will assist author in deposition process (Table 4.12).

Consideration: *Publishers' and Funders' Embargo*

View of Researcher(s)

This issue has been discussed (section 4.2.1.6) though several legal points are missing in the literature. No expressive study has been reported. Generally many publishers – but certainly not all – stipulate an embargo period before an article can be made OA. This is a result of publishers' fears of falling sales. Most OA policies will acknowledge this and permit embargoes so that authors are not placed in a position of difficulty with respect to their publisher. It is found that 66% publishers allow some form of self-archiving of the final version of an article but require an embargo period during which OA is not allowed (SHERPA/RoMEO, 2011).

Analysis of Roarmap Database

Only a few IDRs have clearly stated this policy and it is also found that most of the IDRs allow authors to submit items in any time but it (items) will be viewed by public after embargo period has expired (4.12).

Consideration: Workflow Design and Management

View of Researcher(s)

A repository workflow is a breakdown of the administrative tasks involved. There are several types of workflow in a typical repository depending upon types of documents and software used (Hulse, Cheverie & Dygert, 2007; Campbell, Blinco & Mason, 2004; Nolan & Costanza, 2006). Generally these include workflows to manage user registration and administration; workflows to manage authorization and permissions within the repository; and various administrative workflows to allow for maintenance and software updates. However, the most significant workflow focuses on the submissions process. This workflow is crucial as it will be used regularly by a wide variety of depositors. DSpace allows creating up to three (3) workflows steps in submission mentioned below with explanation (Fig. 4.15 & Fig. 4.16):

Submission → accept/reject (workflow 1) → review (workflow 2) → metadata validation (workflow 3).

- *Workflow 1: Accept/Reject Step:* This step is used to allow a user to simply accept an item, or reject it. If they reject it, they can give a reason which will be emailed to the submitter. The item will appear back in the submitter's 'My DSpace', if it is rejected;
- *Workflow 2: Accept/Reject/Edit Metadata Step:* This step is used to allow E-person to either accept or reject an item, and edit its metadata. If they reject it, they can give a reason which will be emailed to the submitter. The item will appear back in the submitter's 'My DSpace' if

it is rejected. But they can not change the submitted files. They can accept submission for inclusion, or reject submission; and

- *Workflow 3: Edit Metadata Step:* This step is used to allow the user to edit the metadata. This might be done to correct the metadata, or to improve it. But they can not change the submitted files. They must then commit to archive; may not reject submission.

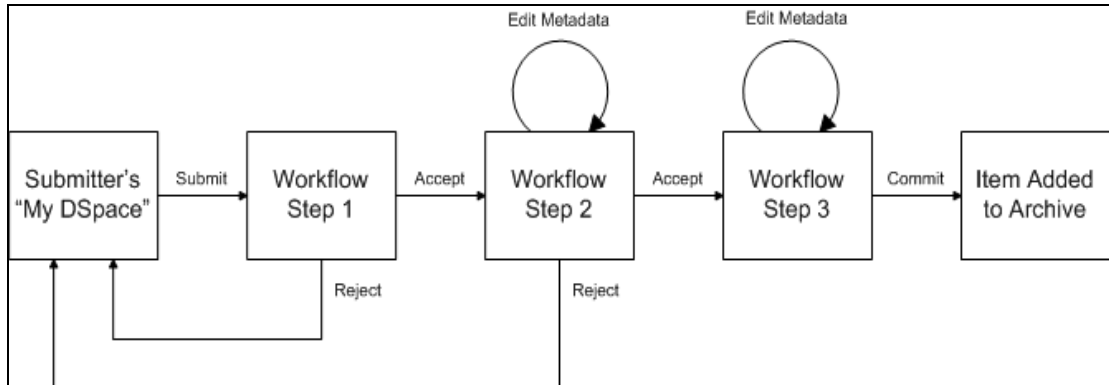


Fig. 4.15: Workflow Management Flowchart

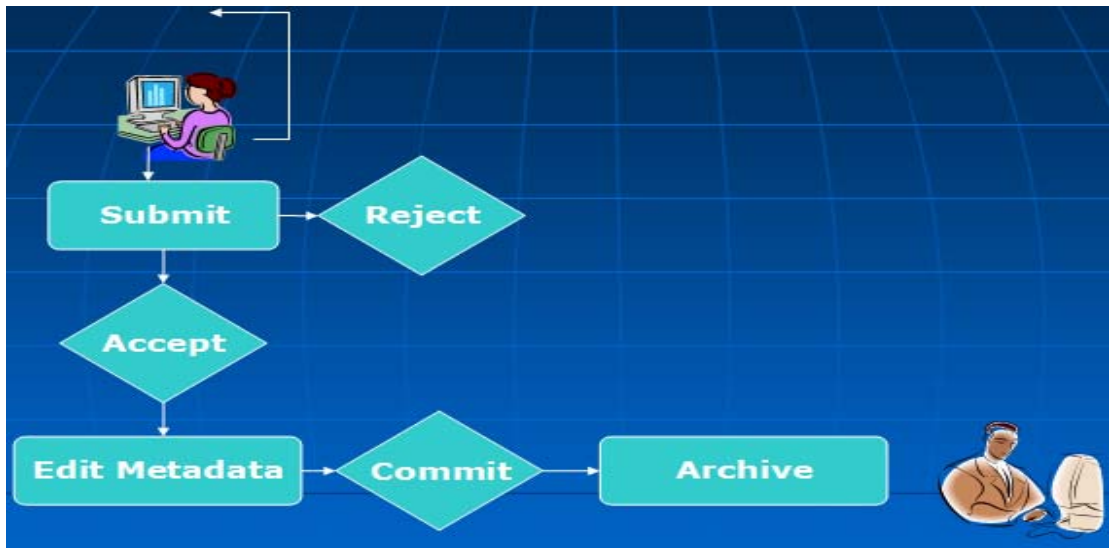


Fig. 4.16: Graphical Representation of Workflow Management

The sequence is this: The Collection receives a submission. If the Collection has a group assigned for workflow step 1, that step is invoked, and the group is notified. Otherwise, workflow step 1 is skipped. Likewise, workflow steps 2 and 3 are performed if and only if the Collection has a group assigned to those steps. Though designing workflow is not mandatory for creating Collection. But it is not a good idea to avoid defining workflow. If administrators do not define any workflow, the moment an author submits an item to system, the item will go directly go to the archive. In which case, there is every possibility of allowing authors to deposit

irrelevant item. However system administrator can decide on how many workflows are to be defined for a Collection. Any or all of the steps may be used. Even administrator may edit, delete or skip a workflow step. The following are the graphical representation of submission workflow.

Analysis of Roarmap Database

It is found that most of the repositories follow the workflow as included in the software used. But it is not clear whether repositories follow all three steps or any one of them. Below are the explanations on the basis of which the following table (4.12) has been prepared.

A = Accredited members of the organization or their delegated agents; B = Items can be deposited at any time, but will not be made publicly visible until publishers' or funders' embargo period has expired; C = Items may not be deposited until any publishers' or funders' embargo period has expired

Name of the Repository	Policy related to Submission		
	Eligible Depositors	Deposition Rules	Publishers' and Funders' Embargo
Anglia Ruskin Research Online	Accredited members of the organization or their delegated agents		
Archive ouverte UNIGE	A	Authors may only submit their own work for archiving	B
Arts and Humanities Research Council	A	√	B
ANU Research repository	A		
Arizona State University Digital Repository	A		
Aston University Research Archive	A	√	B
Bond University	A		
Brigham Young University Library	A		
Canadian Health Services Research Foundation	A	√	B
Canadian Institutes of Health Research	A	√	B
California Digital Library (CDL)	A		
California Institute of Technology	either personally or with the help of library staff		
Canadian Cancer Society	A	√	B
Concordia University	A	√	B
Centre for Environmental Data Archival Repository	A		B

Name of the Repository	Policy related to Submission		
	Eligible Depositors	Deposition Rules	Publishers' and Funders' Embargo
Charles Sturt University Institutional Repository	A		B
Covenant University Repository	A	√	B
Council of Scientific and Industrial Research	A	√	B
Curtin University	A		B
Edith Cowan University	A		B
European Heads of Research Councils	A	√	B
European Research Advisory Board	A	√	B
European Research Council	A	√	B
European University Association	A	√	B
Fonds de la recherche en sante Quebec	A	√	B
Fonds zur Foerderung der wissenschaftlichen Forschung	A	√	B
Genome Canada	A	√	B
Goddard Library Repository	A		B
Griffith University	A	√	B
Heart and Stroke Foundation of Canada	A	√	B
HKUST Institutional Repository	Faculty, Staff & PhD students	√	C
Joint Information Systems Committee	A	√	B
Katholieke Universiteit Leuven	A	√	B
Khazar University	A	√	B
Kwame Nkrumah University of Science and Technology Institutional Repository (KNUSTSpace)	A		B
Leeds Metropolitan University institutional repository	A		B
Leicester Research Archive	A	√	B
Loughborough University	A	√	B
Michael Smith Foundation for Health Research	A	√	B
Monash University	A		B
National Research Council	A	√	B
Natural Environmental Research Council	A		B
Natural Sciences and Engineering Research Council of Canada	A	√	B

Name of the Repository	Policy related to Submission		
	Eligible Depositors	Deposition Rules	Publishers' and Funders' Embargo
Northern Melbourne Institute of TAFE	A	√	B
University of Nottingham	A	√	B
Ontario Institute for Cancer Research	A	√	B
Queensland University of Technology	A		
Stanford University: School of Education	A	√	B
University of Strathclyde Institutional Repository (Strathprints)	A	√	B
Teesside University's Institutional Repository (TeesRep)	A	√	B
Trento University	A	√	B
Universidad Nacional de Colombia	A	√	B
University of Abertay Dundee	A		B
University of Birmingham Research Archive	A		B
University of Bath	A		B
University of Calgary: Library and Cultural Resources	A	√	B
University of East Anglia	A	√	B
University of Edinburgh	A		B
University of Florida Institutional Repository			C
University of Helsinki			B
University of Huddersfield	Staff, researcher or postgraduate student		
University of Kansas	Faculty, staff along with researchers		
University of Lincoln	A	√	B
University of Melbourne Eprint Repository	A		B
University of New South Wales	A		B
University of Nottingham	A		B
University of Queensland	A		B
University of Pittsburgh	A	√	B
University of Reading	A	√	B
University of Salford	A	√	B
University of Starling (STORRE)	A	√	B
University of Surrey	A	√	C
University of Sydney	A		
University of Virginia	A	√	B

Name of the Repository	Policy related to Submission		
	Eligible Depositors	Deposition Rules	Publishers' and Funders' Embargo
University of Westminster	A		B
Victoria University Institutional Repository	A	√	B
Wake Forest University Institutional Repository	A		B
Warwick Research Archive Portal	A		B
York St John University	A		B

Table 4.12: Submission Policy

Recommendation(s)

A set of recommendations are drawn as Submission Policy for BURA on the basis of the discussion made in this particular section 4.2.1.12 and additional notes are given below⁵:

1. *Authors may submit their own work in digital format or they may ask the library for assistance;*
2. *Every Community may determine the specific submission policies for its collections;*
3. *BURA may follow three workflows in submission process;*
4. *BURA may create separate submitters, reviewers, metadata editors and approvers for each collection, if required;*
5. *Someone, whether from the library or the community itself, will revise and check new submissions to make sure the contents is appropriate for the collections & submitted by authorized submitter;*

⁵ Authors/Contributors are responsible for checking rights but the repository (BURA) staff may also check any agreements or policies that are publicly available via the RoMEO database or that are made available to them by the author. Outputs may not be made available in BURA if publisher agreements do not permit access.

The validity and authenticity of the contents of submissions (all materials submitted by the depositor, including full data and metadata) is the sole responsibility of the depositor, and may not be checked by the BURA.

Workflow steps are worked through in order. If step 1 and 3 are selected, step 1 must be completed before step 3 will be initiated.

6. *IR staff can reject or return submitted file to the concerned author for modifications in the metadata or if there are problems with the electronic file;*
7. *Articles are to be submitted immediately upon acceptance for publication and after embargo periods have expired, otherwise it will not be accepted or will not be made publicly visible;*
8. *Author may submit object in any format but preferable format is PDF and formats other than PDF will be converted to PDF format;*
9. *Authors must deposit minimum metadata for all their items. If required, IR staff can add/modify metadata;*
10. *Submitted items are not vetted by the BURA administrator; and*
11. *Where an item has multiple authors and they have retained copyright in the work, the depositing author must obtain permission from all the other contributing authors before depositing the work.*

4.2.1.13 System Management and Administrative Policy

In this policy two typical questions need to answer when proposed are who will manage and control the archive/or repository and where will it be located? Academics need to know who is responsible for running the archive and how to get in contact with them in case they need help or advice.

Consideration: *Who will manage and control the Repository*

View of Researcher(s)

Libraries and their staff play a significant role in the development of IR. "Linking people to resources" (O'Brien, 2005) has been the task of information specialists for many years. Several studies (Branin, 2002; Bailey, 2005; Bailey et al., 2006a; Pelizzari, 2005; Ware, 2004; Joint, 2006c; Chang, 2003) support this view by saying that library is the appropriate locus for this projects and librarians take the lead in running IR (Quint, 2002; Gibbons, 2004; Allard, Mack & Feltner-Reichert, 2005; Chan, Kwok & Yip, 2005; Phillips, Carr & Teal, 2005; Rockman, 2005; Drake, 2004). A survey of CNI members and consortial members reports that 60% of institutions with an operational IR put sole responsibility for IR policy making in the hands of the library (Rieh et al., 2007b).

Another study (Pappalardo & Fitzgerald, 2007) stated that it is the responsibility of the institution to manage the repository and the material in the repository. Ideally, a repository manager should be appointed to deal with these responsibilities. The study also recommends that additional staff can be appointed or library staff can be trained to assist the repository manager where required. The other studies (De Beer, 2005; Kaur & Ping, 2009; Pelizzari, 2003) advocated that library should own and manage the IRs.

Analysis of Roarmap Database

Actually almost all the IDRs have no such policy. Only 9 (nine) IDRs have clearly stated that library will manage the IDRs system (Table 4.13). It is found that MIT has hired a part-time ‘Scholarly Publishing Consultant’ to advise faculty about their open access options within scholarly publishing whereas QUT has a fulltime ‘e-Research Access Coordinator’ for this purpose.

Name of the Repository	Managed and Maintained by
California Digital Library	Library
Goddard Library Repository	Library
HKUST Institutional Repository	Library
Indiana University–Purdue University Indianapolis	Working group of librarians and information technology staff along with other University Library staff
Loughborough University	University Library
Massachusetts Institute of Technology (MIT)	Library
Queensland University of Technology (QUT)	Library
University of Maryland	Library
University of Toronto	Library

Table 4.13: System Management and Administrative Policy

Recommendation(s)

A set of recommendations are drawn as System Management and Administrative Policy for BURA on the basis of the discussion made in this particular section 4.2.1.13:

This research study suggests that BURA will be managed and controlled by the library. If Communities and Collections are limited, system (BURA) should be maintained by administrator. But if the Communities and Collections are huge and distributed in nature then it would be logical to create several super users (collection-level or community level only) for each Community or Collection. Then BURA should be managed and maintained by several super users specified for each Community or Collection.

4.2.1.14 User Interface Policy

User interface plays a vital role for any online digital repository systems. It is the front-end layer for the entire software framework. User interface needs to take care of features like regional or local language based interface, integration of browsing and searching facilities, access to resources arranged under different Communities and Collections, access to communication tools. In fact, the main challenge of designing user interface is to combine the entire user oriented features and facilities of the system in a single window of limited size. So, Unicode-compliant multilingual user interface for browsing, searching and retrieval of IDR resources is essential and a mandatory parameter for any repository software framework. Generally most of the IDRs support and follow the interface(s) as specified by the software and includes the following basic three interfaces:

- One for submitters and others involved in the submission process;
- One for end-users looking for information; and
- One for system administrators.

Consideration: Unicode-compliant Multilingual Interface

View of Researcher(s)

To date, the published information on this area is limited and several technical issues are missing. Several studies (Barton & Waters, 2004–2005; Pappalardo & Fitzgerald, 2007; DINI, 2003; University Grants Commission, 2005; Gibbons, 2004) recommended that user interface ought to be attractive, easy-to-use, customizable and well-documented. Another study (Rieh et al., 2007b) reported that user interface needs serious reworking. The other researchers (Phillips et al., 2005; Hunter & Day, 2005; Feijen et al., 2007) advocated for customization in order to implement a multilingual interface (Peters & Picchi, 1997). Several others exerts (Del Gado & Nielsen, 1996; Head, 1999; Rskin, 2000) pointed out the need of designing local language based interface for any communication system.

Analysis of Roarmap Database

This issue has been neglected by most of the repositories and research/funder organizations. Only a few IDRs have customized user interface and supports searching and browsing of multilingual objects.

Recommendation(s)

A set of recommendations are drawn as User Interface Policy for BURA on the basis of the discussion made in this particular section 4.2.1.14:

1. *Study proposes web-base, Unicode-compliant multilingual interfaces with provision for switching interfaces through browser setting;*
2. *Study also proposes Bengali and Hindi scripts based user interfaces for managing resources and providing services apart from the default English language; and*
3. *Study also proposes that it (user interface) should be easy to understand and use and there should have a provision for customization for adding theme for different communities, collections, items etc.*

4.2.1.15 Version Control Policy

One of the questions that users are most concerned about is version control. This version policy addresses the issues and uncertainties relating to versions of academic papers in digital repositories. Different versions frequently co-exist in publicly available electronic form, alongside formally published versions (<http://www2.lse.ac.uk/library/versions/>). It is found that academic researchers typically produce many revisions and it increases when working with co-authors. They want to make sure that their work is secure and cannot be modified by someone else. They want to make sure that different versions of their work can be correctly identified. The policy aims to help build trust in open access repository contents among all stakeholders. In this policy several key questions arise i.e. how version control is managed, how complaints are managed? Do your systems allow changes to deposited items or do you allow items to be changed after they have been committed to the repository? Do you allow multiple versions? Can *errata* and *corrigenda* be accommodated?

Consideration: *Which version is to be deposited/or archived?*

View of Researcher(s)

In this area no research works have been reported. Not a single study cover the issues discussed in this policy. All these issues have not been highlighted in literature and no relevant published documents have been found. Green, Macdonald & Rice (2009) recommended that the earlier version may be withdrawn from public view and there will be links between earlier and later versions, with the most recent version clearly identified. The study also recommended that item's persistent identifier will always link to the latest version. Another study (Gibbons, 2004) is in support and suggested

that there should be the persistent URL (Uniform Resource Locator) with the original version.

Analysis of Roarmap Database

It is found (Table 4.14) that, in the event of errors, authors has to give the corrected files but is not allowed to change the deposited items. A few IDRs suggested that an errata and corrigenda lists may be provided with the original record. Below are the explanations on the basis of which the following table (4.14) has been prepared.

A = Changes to deposited items are not permitted; B = If necessary, an updated version may be deposited; C = Both (A+C)

Name of the repository	<ul style="list-style-type: none"> • Changes to deposited items are not permitted • If necessary, an updated version may be deposited 	Inclusion of Errata and Corrigenda lists with the original record
Aston University Research Archive	B	
Bond University	B	
Covenant University	A	√
Edith Cowan University	C	√
HKUST Institutional Repository	C	√
Katholieke Universiteit Leuven	B	
Leeds Metropolitan University	C	√
Leicester Research Archive	C	√
Loughborough University	C	
Natural Environmental Research Council	C	√
Penn's Institutional Repository	B	
University of Strathclyde Institutional Repository (Strathprints)	C	
TeesRep, Teesside University's Institutional Repository	C	√
Trento University	B	√
Universidad Nacional de Colombia	C	
University of Bath	C	√
University of Calgary: Library and Cultural Resources	A	Exceptions may apply
University of East Anglia	C	Inclusion of Errata and Corrigenda lists with the original record
University of Edinburgh	B	√
University of Leicester	B	
University of Lincoln	C	√
University of Nottingham	A	√
University of Reading	C	√

Name of the repository	<ul style="list-style-type: none"> • Changes to deposited items are not permitted • If necessary, an updated version may be deposited 	Inclusion of Errata and Corrigenda lists with the original record
University of Salford	B	√
University of Stirling	C	√
University of Surrey	C	
University of Westminster	B	
Warwick Research Archive Portal	C	
York St John University	B	

Table 4.14: Version Control Policy

Recommendation(s)

A set of recommendations are drawn as Version Control Policy for BURA on the basis of the discussion made in this particular section 4.2.1.15:

1. *BURA will keep original updated version;*
2. *Work submitted to BURA cannot be revised post publication;*
3. *Changes to deposited items are not permitted. However, authors are allowed to post subsequent versions of their work to show the progression of their research work;*
4. *An updated version may be deposited, if necessary. The earlier version may be withdrawn from public view;*
5. *The original bit stream is retained for all items, in addition to any upgraded formats;*
6. *Errata and corrigenda lists may be included with the original record if required; and*
7. *There will be links between earlier and later versions, with the most recent version clearly identified. The original URL (Uniform Resource Locator) or persistent identifier will be linked to the latest version.*

4.2.1.16 Withdrawal Policy

Several key questions may arise in this policy i.e. will system allow contents to be withdrawn or how are items withdrawn? If yes, in which circumstances and how this may be carried out e.g. if withdrawal means complete deletion of a metadata record as well as removal of the offending resource. Will you remove just the files or will you also remove the metadata record describing the file contents? Are they deleted entirely, or do you just remove them from public view? Do the original URLs (Universal Resource Location/Locator) remain valid, and if so, do they point to 'tombstone' citations or to replacement items? Will you keep original record with URL?

Consideration: Acceptable reasons for withdrawal of items

View of Researcher(s)

Studies strongly discourages withdrawal of items (Ware, 2004; Proberts & Jenkins, 2006) because one definition of IRs is that items should be cumulative and perpetual (Johnson, 2002). This study (Proberts & Jenkins, 2006) concluded that there will always be a record of the resources, even if it is removed. This is to ensure that it is possible for a user of the IR to know what has happened to that record. Here withdrawn items are not deleted from the repository, but are removed from public view. However, this view may not be shared by all IR managers. Green, Macdonald & Rice (2009) stated several reasons/conditions for withdrawal of contents from the repository.

Analysis of Roarmap Database

Policies governing the removal of materials from storage by IDRs may vary, some repositories maintain 'one-way door' policies; however, under certain circumstances, permit materials to be removed and reintegrated (Table 4.15). It is found that the majority of policies covered allows withdrawal of items and outlines a variety of legitimate circumstances under which an object may be withdrawn from archive (Table 4.15).

Another question is what happens with their publications when a member (generally academicians or faculty members) of the community leaves the institution? It is found that academics don't always spend their entire lives at a single university. Whether the contents will stay in the archive or they will be able to continue to add new contents from wherever they are in the future. To date, the published information about this study is missing. No research work has been reported in this area.

Name of the Repository	Acceptable reasons for withdrawal of items
Anglia Ruskin Research Online	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research
Archive ouverte UNIGE	√
Arizona State University Digital Repository	Legal issues (copyright violation or violation of the terms of the depositor's agreement); Plagiarism
Aston University Research Archive	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research
Arts and Humanities Research Council	√
Brigham Young University Library	Publisher or creator requests
California Digital Library	submission errors, rights violations, or inappropriate content
Canadian Cancer Society	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research
Canadian Health Services Research Foundation	√
Canadian Institutes of Health Research	√
Centre for Environmental Data Archival Repository	√
Covenant University Repository	√
Cornell University Library	Request of the author legal order due to a violation of eCommons policy
Council of Scientific and Industrial Research	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research
Edith Cowan University	√
European Heads of Research Councils	√
European Research Advisory Board	√
European Research Council	√
European University Association	√
Fonds de la recherche en sante Quebec	√
Fonds zur Foerderung der wissenschaftlichen Forschung	√
Genome Canada	√
Heart and Stroke Foundation of Canada	√
Indiana University–Purdue University Indianapolis	request of the author; IUPUI's discretion; IUPUI libraries' discretion; legal order"
Joint Information Systems Committee	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research
Katholieke Universiteit Leuven	√
Khazar University	√
Kwame Nkrumah University of Science and Technology Institutional Repository	√
Leeds Metropolitan University institutional repository	√
Leicester Research Archive Policies	√
Loughborough University	√

Name of the Repository	Acceptable reasons for withdrawal of items
Massachusetts Institute of Technology	request of the author; MIT's discretion; MIT libraries' discretion; legal order"
Michael Smith Foundation for Health Research	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research request of the author/copyright holder
Natural Environmental Research Council	Michael Smith Foundation for Health Research
National Research Council	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research
Natural Sciences and Engineering Research Council of Canada	√
Northern Melbourne Institute of TAFE	√
University of Nottingham	√
Ontario Institute for Cancer Research	√
Penn's Institutional Repository	Under special circumstances
Stanford University (School of Education)	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research
University of Strathclyde Institutional Repository (Strathprints)	√
Teesside University's Institutional Repository (TeesRep)	√
Trento University	√
Universidad Nacional de Colombia	√
University of Abertay Dundee	discretion of the University; material commercially sensitive or confidential; publisher or funder agreements or conditions; restricted by copyright
University of Bath	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research
University of Calgary (Library and Cultural Resources)	Queries from publishers or other copyright owners; Queries from co-authors
University of East Anglia	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research
University of Edinburgh	√
University of Florida Institutional Repository	√
University of Helsinki	√
University of Lincoln	√
University of Melbourne Eprint Repository	Plagiarism; request of the author; publishers desire
University of Nottingham	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research
University of Pittsburgh	√
University of Reading	√
University of Salford	√
University of Stirling Open Access Institutional Repository	√
University of Surrey	√
University of Virginia	√

Name of the Repository	Acceptable reasons for withdrawal of items
University of Westminster	√
Wake Forest University Institutional Repository	request of the author; request of the community; WFU's discretion; Libraries' discretion; legal order
Warwick Research Archive Portal	Publisher's rules; Copyright violation; Plagiarism; National Security; Falsified research
York St John University	√

Table 4.15: Withdrawal Policy

Recommendation(s)

A set of recommendations are drawn as Withdrawal Policy for BURA on the basis of the discussion made in this particular section 4.2.1.16 and outlines the circumstances under which withdrawal of contents may be possible and additional notes are given below⁶:

1. *Falsified research*
2. *National security*
3. *Copy right violation or plagiarism*
4. *Journal publisher's rule*
5. *If the journal in which a paper is formally published requires it*
6. *In case of submission error*
7. *In case of inappropriate contents*
8. *If the academic or copy right holder decides to remove it.*

⁶*Removal* means removed from the databases and *Withdrawal* means remove from the public view but it will remain in database.

If academician leaves the institution their items will be retained in BURA and they can deposit contents to BURA because once a faculty member, always a faculty member.

4.2.1.16.1 Withdrawn Items Policy

This policy addresses issues and uncertainties about withdrawn items and it is important to define whether will items be deleted entirely, or do you just remove them from public view? Do the original URLs remain valid, and if so, do they point to 'tombstone' citations or to replacement items? Will you keep original record with URL?

Consideration: *Whether withdrawn items are deleted from database*

View of Researcher(s)

In this area no research works have been reported. Not a single study cover the issues discussed in this policy. These issues have not been highlighted in literature and no relevant published documents have been found.

Analysis of Roarmap Database

It is found that the majority of IDRs support that withdrawn items will be in databases and corresponding identifiers/URLs will be kept for ever to know what happened with that item (Table 4.16).

Name of the Repository	Withdrawn items are not deleted per se, but are removed from public view (e.g. Purging)	Withdrawn items' identifiers/URLs are retained indefinitely
Aston University Research Archive	Withdrawn items are deleted entirely from the database.	√
Centre for Environmental Data Archival (CEDA) Repository	√	√
Arts and Humanities Research Council (AHRC)	√	√
Canadian Cancer Society	√	√
Canadian Health Services Research Foundation	√	√
Canadian Institutes of Health Research	√	√
Covenant University	Withdrawn items are not deleted per se, but are removed from public view	√
Council of Scientific and Industrial Research	Withdrawn items are deleted entirely from the database	√
Edith Cowan University	Withdrawn items are not deleted per se, but are removed from public view	√
European Heads of Research Councils	√	√

Name of the Repository	Withdrawn items are not deleted per se, but are removed from public view (e.g. Purging)	Withdrawn items' identifiers/URLs are retained indefinitely
European Research Advisory Board	√	√
European Research Council	√	√
European University Association	√	√
Fonds de la recherche en sante Quebec	√	√
Fonds zur Foerderung der wissenschaftlichen Forschung (FWF)	√	√
Genome Canada	√	√
Heart and Stroke Foundation of Canada	√	√
Joint Information Systems Committee (JISC)	√	√
Katholieke Universiteit Leuven	√	√
Khazar University	√	√
Kwame Nkrumah University of Science and Technology Institutional Repository (KNUSTSpace)	√	√
Leeds Metropolitan University institutional repository	√	√
Leicester Research Archive	√	√
Loughborough University	√	√
Michael Smith Foundation for Health Research	√	√
Natural Environmental Research Council	√	√
National Research Council	√	√
Natural Sciences and Engineering Research Council of Canada (NSERC)	√	√
Northern Melbourne Institute of TAFE	√	√
Ontario Institute for Cancer Research	√	√
St John University	√	√
Stanford University (School of Education)	√	√
Teesside University's Institutional Repository (TeesRep)	√	√
Trento University	√	√
Universidad Nacional de Colombia	Documents that are removed are completely deleted from the database	√
University of Bath	Withdrawn items are not deleted per se, but are removed from public view	√
University of Calgary (Library and Cultural Resources)	√	√
University of East Anglia	√	√
University of Edinburgh (ERA)	√	√

Name of the Repository	Withdrawn items are not deleted per se, but are removed from public view (e.g. Purging)	Withdrawn items' identifiers/URLs are retained indefinitely
University of Lincoln	✓	✓
University of Reading	✓	✓
University of Salford	✓	✓
University of Stirling	✓	✓
University of Surrey	✓	✓
University of Nottingham	✓	✓
University of Strathclyde	✓	✓
Institutional Repository (Strathprints)	✓	✓
University of Virginia	✓	✓
Warwick Research Archive Portal	✓	✓
York St John University	Withdrawn items may be deleted or at least removed from public view	✓

Table 4.16: Withdrawn Items Policy

Recommendation(s)

A set of recommendations are drawn as Withdrawn Items Policy for BURA on the basis of the discussion made in this particular section 4.2.1.16.1:

1. *Withdrawn items are not deleted per se, but are removed from public view; and*
2. *Withdrawn items' identifiers/URLs are retained indefinitely.*

4.2.1.17 Technical Parameters

There are a wide variety of technical issues related to starting up an IDR. In order to create an effective digital repository it is important that the technical set-up process is planned in detail. Several technical issues arise with respect to digital archive. The basic infrastructure in terms of hardware and software and the decision whether to adopt open source software or opt for commercial packages. Several studies (Branin, 2002; Barton & Walker, 2002; Crow, 2002a, 2002b; University Grants Commission, 2005) pointed out that the main technological issues for a new IDR will be to select from the several viable software options available and to size the server and storage space requirements. This section forms a technical framework, guiding you through the key decisions, options and processes involved in the creation of a repository infrastructure, such as:

1. *Platform requirements;*
2. *OSS (meaning the software is freely available for download and installation) or commercial package;*
3. *Operating system;*
4. *Hardware;*
5. *Network components;*
6. *Standards;*
7. *Web Server; and*
8. *Backend Database Management Software.*

4.2.2 Standards

This section introduced the concept of standard and established the importance of domain-specific metadata standard in digital library environment. Standards can be defined as "documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose (Bryden, 2003). The process of developing and attaining standards for libraries has taken seriously by library professionals since the second Great War. The movement started in America and gained strength and support from countries across the globe. Standards can be de jure or de facto and proprietary or open. In library world some standards are merely best-practice guidelines and some standards are developed through formal process by professional associations or national institutions in the domain of library activities. Library professionals are generally interested in their own national standard (e.g. Bureau of Indian Standards (BIS), British Standard Institutes (BSI) etc.), in ISO standards (International Organization for Standardization), and in NISO standards. National Institute of Standard Organization (NISO) is the institute that ANSI (American National Standard Institute) accredits for the purpose of developing standards in library and information services. Hopkinson (2006) grouped standards in the domain of library services by their applications: describing and identifying information resources, information exchange, managing collections, and delivering services. The goal of standards is to provide consistency in data structures and communication protocols for objects and cross-system workflows. In digital environment, standards help in achieving:

- Interoperability (operability across a wide variety of hardware, operating systems, web browsers and Learning Management Systems);
- Re-usability (possible modification and use by many different development tools);
- Manageability (managing and capturing all type of resources);
- Accessibility (indexing and tracking on demand); and
- Durability (no need for modification as versions of system software change).

A. Role of Library Standards

Libraries are now operating in a distributed networked environment, where standards are essential for efficiency and interoperability. Order, collaboration and interoperability are three most important prerequisites for effective information services. All these requirements depend on standards. Library services have long depended on shared standards. For example, the adoption of standardized cataloging codes, standard bibliographic data elements, subject access systems, and standardized subject classification schemes by libraries all over the world are two extremely important events in the history of library standards.

Dewatripont et al. (2006) reported that a lot of standards and new technologies have been developed, collaboration and standardization are essential to increase interoperability across systems and platforms in order to: facilitate the efficient dissemination of scholarly contents, improve their visibility, open up access to a wide range of digital materials and ensure their long-term preservation (e.g. promote existing standards through metadata registries and create crosswalks between metadata standards). Karen Coyle (Coyle, 2002) reported that the very first instance of the library technology standards was the decision at the first annual ALA meeting in September of 1877 to standardize the catalog card at 7.5 x 12.5 cm. The purpose of this dimensional standard was to make large scale production and distribution of cards. Libraries across the world followed this standard and in 1898 the Library of Congress (LoC) began its printed cards service. In the same paper he also opined that the card-size standard was the key to interoperability of this card catalogue service and LoC cards service may be considered as the precursor of bibliographic data services like MARC-formatted record service. And we all know the role of standard bibliographic formats like MARC in library automation.

South African Library Association (1968) defined library standards “as the criteria by which library services may be measured and assessed. They are determined by professional librarians in order to attain and maintain the objectives they have set themselves. Standards may be interpreted variously as the pattern of an ideal, a model procedure, a measure for appraisal, a stimulus for future development and improvement and as instrument to assist decision and action not only by librarians themselves, but by the laymen concerned indirectly with the institution, planning, and

administration of library service.” This excellent definition reveals that library standards may be viewed as a crucial aid for library professionals and authorities in order

- to act as the pattern of an ideal;
- to set a model procedure;
- to establish measure for appraisal;
- to act as stimulus for future development and importance; and
- to help as an instrument to assist decision and action.

B. Emerging Library Standards

Most of the library standards are formal standards or de jury standards. Apart from these formal standards, there are a few specifications (you may consider these as de facto standards) in the domain of library services, which are widely in use across different library systems in different countries. Most of these internationally agreed upon informal standards are developed by national libraries (e.g. Library of Congress) and library associations (e.g. ALA, IFLA etc.). Some of these very important non-formal standards are –

- MARCXML - MARC 21 data in an XML structure (developed by Library of Congress - <http://www.loc.gov/standards/marcxml/>);
- MODS (Metadata Object Description Standard) - XML markup for selected metadata from existing MARC 21 records as well as original resource description (developed by Library of Congress - <http://www.loc.gov/standards/mods/>);
- MADS (Metadata Authority Description Standard) - XML markup for selected authority data from MARC21 records as well as original authority data (developed by Library of Congress - <http://www.loc.gov/standards/mads/>);
- METS (Metadata Encoding & Transmission Standard) - Structure for encoding descriptive, administrative, and structural metadata (developed by Library of Congress - <http://www.loc.gov/mets/>);
- PREMIS (Preservation Metadata) - A data dictionary and supporting XML schemas for core preservation metadata needed to support the long-term preservation of digital materials. (developed by Library of Congress - <http://www.loc.gov/standards/premis/>);
- SRU/SRW (Search and Retrieve URL/Web Service) - Web services for search and retrieval based on Z39.50 (developed by Library of Congress - semantics <http://www.loc.gov/standards/sru/>); and
- OAI/PMH Version 2.0 - Open Archive Initiative/Protocol for Metadata Harvesting (developed by Open Archive Initiative).

C. Standards for Automated and Digital Library System

It is now time to face the most important question from the perspective of a library professional. What are the essential and must-to-follow standards in the domain of automated and digital library systems? It’s a difficult question in view of the fact that

a single set of standards may not be equally applicable to library of any type or size. However, a set of minimum standards may be identified for automated and digital library systems.

C.1. Standards for automated library systems

- ISO – 2709 for bibliographic data interoperability;
- Standard bibliographic format compliant with ISO - 2709 (e.g. MARC 21, UNIMARC, CCF/B);
- Z 39.50 protocol standard for copy cataloguing;
- Z39.71 standard for holdings statements;
- BS ISO 9735-9:2002 Electronic data interchange for administration, commerce and transport (EDIFACT);
- Z39.83-1 (NISO Circulation Interchange Part 1: Protocol (NCIP));
- Z39.83-2 (NISO Circulation Interchange Part 2: Protocol (NCIP));
- ISO/CD 28560-1 (Information and documentation -- Data model for use of radio frequency identifier (RFID) in libraries -- Part 1: General requirements and data elements);
- ISO/CD 28560-2 (Information and documentation -- Data model for use of radio frequency identifier (RFID) in libraries -- Part 2: Encoding based on ISO/IEC 15962); and
- ISO/CD 28560-3 (Information and documentation -- Data model for use of radio frequency identifier (RFID) in libraries -- Part 3: Fixed length encoding).

C.2. Standards for digital library systems

- ANSI/NISO Z39.85-2007 for metadata encoding;
- ISO/CD 26324 for Digital object identifier system;
- MODS (Metadata Object Description Standard) - XML markup for selected metadata from existing MARC 21 records as well as original resource description (developed by Library of Congress - <http://www.loc.gov/standards/mods/>);
- METS (Metadata Encoding & Transmission Standard) - Structure for encoding descriptive, administrative, and structural metadata (developed by Library of Congress - <http://www.loc.gov/mets/>);
- OAI/PMH Version 2.0 Open Archive Initiative/Protocol for Metadata Harvesting (developed by Open Archive Initiative); and
- ISO/TR 21449:2004 (Content Delivery and Rights Management: Functional requirements for identifiers and descriptors for use in the music, film, video, sound recording and publishing industries).

Apart from these domain-specific standards and specifications a library system needs to take into consideration standards developed by organizations like Organization for the Advancement of Structured Information Standards (OASIS) and the World Wide Web Consortium (W3C).

4.2.2.1 Metadata Schema Requirements

This particular section describes different community-specific metadata schemas for selected objects type and compares under selected framed criteria. This research study has decided DCMES as common/default metadata standard for textual documents but demands domain specific metadata standard for non-textual documents like learning objects, dissertations and theses etc. This section describes the model of description, to be applied to the standards included into the present document.

A. Need of Domain-specific Metadata Schemas

Standards are a part of every day life whether we realize it or not. Standards are required for the interaction of everyday tools and objects. In the context of digital assets, standards include file formats, network, data format, interoperability, identifiers (such as URLs), and others. In the context of metadata related to digital assets and their retrieval and management, there are a number of standards that should inform development (Fig. 4.2.2.1). For example, DSpace (software for IDR Cluster) uses (by default) Dublin Core (DC) metadata standard which is world standard for description of digital resources and is also used to describe learning objects. The basic DC sets consists of 15 elements and qualified set has about 65 elements. These fields, being generic for any type of digital resource, do not capture any information about the potential educational use of the object. Although DC attributes that contains metadata such as authors, title or granularity, are definitely useful for describing learning contents, but DC does not contain attributes describing the pedagogical perspective of a document.

The question that we must answer is whether each package collects enough information for learning objects, E-theses and whether the data that is collected is extensible or flexible in any way. It is found that no single metadata element set will accommodate the functional requirements of all organizations or communities of practice. Not a single schema is sufficient enough to describe different type of resources with all relevant elements. It may be the case for metadata standards that not a single standard will suit all the needs of a digital asset management system. Most of these metadata schemas have different element sets, attributes etc and to interpret them can be quite a daunting task. It may be the type of resource we are creating; the domain we work in; the particular tasks we want to carry out; and the level to which we want our resource to complement and perhaps be searched alongside other related collections.

Anido et al. (2003) specify that metadata standards describe the information used to define, as precisely as possible, educational contents. This enables potential learners

and developers to find the contents they need (Horton & Horton, 2003). Olivier & Liber (2003) add that metadata standards provide a reasonably uniform way to describe learning resources, so that they can be discovered and accessed. Metadata standards specify how developers can prepare descriptions of their courses and other learning modules so that the LMS can compile catalogues of available learning contents (Horton & Horton, 2003). He further stated that the main goal of the e-learning standardization process is interoperability among authoring contents, tools and management systems.

Therefore there is a need to incorporate community-specific metadata standard to describe various non-textual resources. There are many considerations to take into account when choosing metadata standard(s) that best fit your resources and your users' needs. Evaluating a standard should be done with context, purpose and target user group in mind. So, there is a need to develop a comparative study in order to find the differences and similarities at least in the most famous standards in order to be able to translate one standard into another. The goal of these criteria is not to select the 'best' schema. The purpose of this comparison is to provide a reference for the learning object metadata elements proposed by the organizations involved in their standardization. In this section, the study presents different domain-specific metadata standards (both for theses and dissertations and for learning objects) and their comparison in terms of metadata standard used, type of annotation, subject domain, types of searching facilities etc.

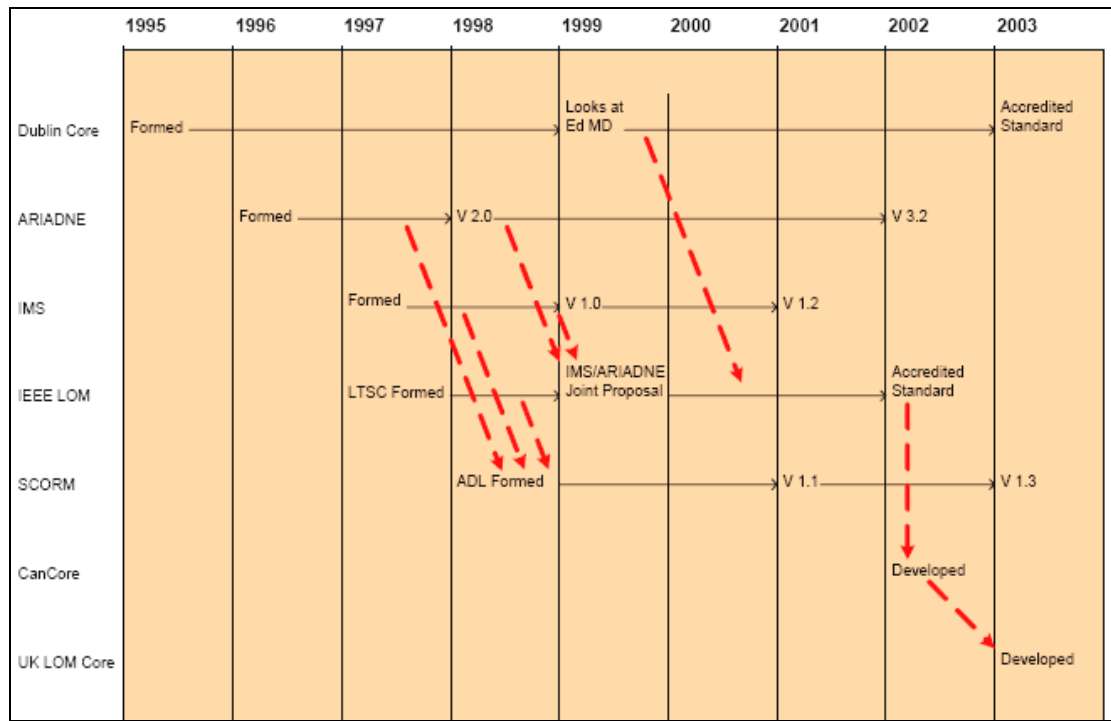


Fig. 4.2.2.1: Timeline of Metadata Schema Development (Source: Krull, 2004)

The metadata standardization process is an active and dynamic process with a wide variety of organizations collaboratively contributing to the process (Table 4.2.2.1). Although many e-learning standards are still in the development phase and not yet fully completed, the value of implementing e-learning standards in the learning object economy cannot be overlooked. Generally, LOM standard has more tags than other standards, it is more general, the others more specific. From an initial analysis, it seems that a lot of metadata is devoted to administering and reusing resources, but educational information should be extended, in order to provide more expressiveness in describing educational contexts and targets to which such resources could be addressed.

Initiative	Organisation	Acronym
Learning Technologies Standardisation Committee	IEEE	LTSC
Joint Committee for the Standardisation of Learning Technologies	ISO and IEC	JTC1 SC36
Dublin Core Educational Metadata	DCMI	DC-ED
IMS Project and Consortium	EDUCAUSE	IMS
Advanced Distributed Learning	US Department of Defence	ADL
Aviation Industry CBT Committee	US Aviation Industry	AICC
Advanced Learning Infrastructure Consortium	Japanese Department of Defence	ALIC
Education Network Australia	Australian Government	EdNA
Alliance of Remote Instructional Authoring and Distributed Networks for Europe	European Commission	ARIADNE
Getting Educational Systems Talking Across Leading edge Technologies	European Commission	GESTALT
PROMoting Multimedia access to Education and Training in EUROpean Society	European Commission	PROMETEUS
Learning Technologies Workshop	CEN	CEN/ISSS/LT
Gateway to Educational Materials	US Department of Education	GEM
National Science, Mathematics, Engineering and Technology Education Digital Library	NSDL	NSDL Metadata

Table 4.2.2.1: Standards Initiatives
(Source: Anido et al., 2002)

B. Selection of Metadata Schema for Learning Objects

This research investigates the development and adoption of educational metadata standards for the widespread use of learning objects. Learning objects, metadata, the related IEEE standard and the various application profiles derived from the standard are discussed. Metadata for E-Learning has existed for several years. Several open metadata standards have been emerged for learning objects and applied to the e-learning fields. There is a variety of metadata schemas currently in use for organizing digital learning collections, only a few of them are widely used in digital repositories. Different educational metadata have been developed to take care of different requirements. Most of these metadata have different element sets, attributes etc and to interpret them can be quite a daunting task, as there are no mandatory elements prescribed by the different standards, different implementations can have anything from just two or three elements up to well over a 100.

The popularity of e-learning has led to the development of many learning object repositories that store high quality learning materials specifically created for e-learning. High quality learning materials are expensive to create and it is very important to ensure reuse of learning materials. Reuse of learning materials are made possible by semantically tagging them with standard metadata. Efficient retrieval of learning materials according to the requirement of an e-learner, the learning materials are tagged with a set of metadata which describes educational artifacts such as topic of the document, type of the document etc. In order to cope with educational concerns, various metadata standards have been developed namely IMS Metadata, SCORM, CanCore, GEM and IEEE Learning Object Metadata etc. But the common metadata standards are IEEE–LOM (Institute of Electronic & Electrical Engineering), DCMI (Dublin Core Metadata Initiative) and SCORM (Sharable Courseware Object Reference Model).

B.1 AICC

It was created in 1988; the AICC (Aviation Industry CBT Committee) is an international group of technology-based training professionals. They create CBT-related guidelines for the aviation industry. They publish a variety of recommendations and computer-managed instruction (CMI) guidelines. The AICC's mission is to provide and promote information, guidelines and standards that result in the effective implementation of CBT and WBT. The objectives of the AICC are: to assist airplane operators in development of guidelines which promote the economic and effective implementation of computer-based training (CBT) media; to develop guidelines to enable interoperability and; to provide an open forum for the discussion of CBT (and other) training technologies.

B.2 ARIADNE

The Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE) have developed under the auspices of the European Commission. ARIADNE Foundation for is a no-profit association and is involved in work related to technical specifications, most notably in the area of metadata. The basic goals of the standard are simplicity, understandability and adaptability and metadata are grouped into six categories. The ARIADNE project focuses on the development of tools and methodologies for producing, managing, and reusing computer-based pedagogical elements and telematics-supported training curricula. The main working fields of this alliance are: computer networks for education and learning; methodologies for the development, management and reuse of educational contents; syllabus definition for computer based training; and educational metadata (Anido et al., 2002).

B.3 Dublin Core Metadata Initiative (DCMI)

The Dublin Core Metadata Initiative (<http://dublincore.org/>) is an open forum engaged in the development of interoperable metadata standards that support a broad range of purposes and business models. DCMI is dedicated to promoting the widespread adoption of these standards and developing specialized metadata vocabularies for describing resources that enable more intelligent information discovery systems (Dublin Core, 2003). DCMI activities have been targeted to refine a core foundation of metadata elements to provide semantic information about World Wide Web resources (Anido et al., 2002). The Dublin Core metadata standard (ISO Standard 15836) includes two levels: Simple and Qualified. The simple Dublin Core contains fifteen elements. The elements are *Title*, *Subject*, *Description*, *Type*, *Source*, *Relation*, *Coverage*, *Creator*, *Publisher*, *Contributor*, *Rights*, *Date*, *Format*, *Identifier* and *Language*. The qualified Dublin Core includes three additional elements *Audience*, *Provenance* and *RightsHolder*, as well as a group of element refinements (also called qualifiers) that refine the semantics of the elements in a way that may be useful in resource discovery. The Dublin Core metadata contains metadata elements useful for general purpose applications but it does not contain attributes describing the pedagogical perspective of a document. The mission of DCMI is to make it easier to find resources using the Internet through the following activities: developing metadata standards for discovery across domains; defining frameworks for the interoperation of metadata sets; and facilitating the development of community specific metadata sets.

B.4 IEEE Learning Object Metadata (IEEE - LOM)

It was published by the Institute of Electrical and Electronics Engineers (IEEE) in 2002. The IEEE Learning Object Metadata (<http://ltsc.ieee.org/wg12/index.html>)

aims to develop accredited technical standards, recommended practices, and guides for learning technology). The LOM standard mainly builds on the Dublin Core and is based on the recommendations of IMS and ARIADNE project. It is a multi-part standard contains a description of semantics, vocabulary, and extensions. LOM has a wide set of globally agreed metadata elements which are grouped into nine descriptive categories: General, Life cycle, Meta metadata, Technical, Educational, Rights, Relation, Annotation, and Classification. The LOM data model is a hierarchy of data elements, including aggregate data elements and simple data elements. It specifies a conceptual data schema that defines the structure of a metadata instance for a learning object. It is intended to reference by other standards that define the implementation descriptions of the data schema so that a metadata instance for a learning object can be used by a learning technology system to manage, locate, evaluate or exchange learning objects. The purpose of the IEEE LOM is to facilitate acquisition, search, evaluation and use of learning objects. It is intended to facilitate the sharing and exchange of learning objects by enabling the development of catalogs and inventories while taking into account the diversity of cultural and lingual contexts in which the learning objects and their metadata are reused (IEEE, 2013).

B.5 IMS

The IMS Global Learning Consortium (<http://www.imsglobal.org/>) develops and promotes the adoption of open technical specifications for interoperable learning technology. IMS is based on LOM and Dublin Core metadata. The IMS Global Learning Consortium, Inc. (IMS) project was launched by EDUCAUSE (formerly EDUCOM), a consortium of North American educational institutions and their commercial and government partners to define open technical standards for the interoperation of distributed learning applications and services (Anido et al., 2002). IMS develops and promotes open specifications for facilitating online distributed learning activities such as locating and using educational contents, tracking learner progress, reporting learner performance, and exchanging student records between administrative systems (IMS, 2003). IMS is very attentive to the needs of those in the educational community generally and has the highest recognition within this community of the standards development organizations (Friesen, 2002). The IMS Content Packaging Information Model defines a standardized set of structure that can be used to exchange the learning contents. These structures provide the basis for standardized data bindings that allow the software developers and the implementers to create instructional materials that are interoperable across authoring tools, learning management systems, and run time environments. IMS has two fundamental goals: to define specific guidelines which guarantee interoperability between applications and services in e-learning; and to support guidelines application in international products and services.

B.6 SCORM

SCORM (Sharable Content Object Reference Model) has been developed in 2003 by an organization called Advanced Distributed Learning (ADL). The SCORM Metadata Application Profile directly references the IEEE Learning Object Metadata (LOM) standard. It provides specific guidance for applying metadata to learning resources. SCORM is pretty much accepted as the standard for management of educational contents. It is a collection of specifications adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility and reusability of Web-based learning contents. The SCORM-compliant courses are reusable, accessible, interoperable and durable. It is a model that references and integrates a set of interrelated technical standards, specifications and guidelines designed to meet ADL's functional requirements, such as, accessibility, interoperability, durability and reusability for learning contents and systems.

The study has taken all the parameters and sub-parameters and modified those parameters into three major groups (i.e. Full support, Partial support and No support/or Non-availability of support) for this evaluation. These divisions of number (e.g. 1 indicates full support; 0.5 represents partial support and 0 indicates non-availability of support/no support) for each group ranging from 0-1 have been fixed as follows:

Categories	Marks Allotted
Full support	1
Partial support	0.5
No support	0

Table 4.2.2.2: Marks allotment for selected Categories (E-learning Metadata Standard)

In this section, the study has described different attributes and characteristics of the six (6) most widely adopted standards for educational resources and environments. The comparison criteria are an initial selection devised to help in choosing a certain standard. Nevertheless, it comes out that such choice could not be definitively binding because, in most cases, the specification given through a standard can be mapped to other standards, so that a smooth transition would be possible. The study does not imply that different and/or further criteria may not be devised. As a matter of fact, further work is in progress, which is out of the scope of this report. The following table (4.2.2.3) compares the overall characteristics of the six metadata schemas and discusses issues related to their educational aspects. However, these are not the only metadata standard used to describe learning objects. But in this research work, the following six standards have been selected for comparison on the basis of the following parameters.

Attributes/Parameters	Score (1= full support; 0.5= partial support; 0= no support)					
	AICC	ARIADNE	Dublin Core (DC)	IEEE - LOM	IMS	SCORM
Absence of “dumb down” principle	1	1	0	1	1	1
No requirement of Qualified special entities	1	1	0	1	0	1
Data extraction from the entities	0	0	0	1	1	0
Form of the metadata	0	0	1	1	1	0
Flexibility of metadata schema	1	1	0	0	1	0
Vocabulary management	0	0	0	1	1	1
Multi-language support	0	0	1	1	0	0
Metadata templates	0	0	1	1	0	1
Consistency in presenting information	0.5	0.5	1	1	0	0
Application Programming Interface (API)	0	0	0	1	0	1
Multi-part standard	0	0	0	1	1	1
Learner Profile Tracking, learner progress, performance exchanging student records	0	0	0	1	1	1
Support multiple users	1	1	1	1	1	0
Independent structured data models	0	0	0	1	1	1
Creation of new metadata files	0	0	1	1	0	1
Modification of data in metadata files	0	0	1	1	0	1
Support of the XML	0	0	1	1	1	0
Total Score	4.5	4.5	8.0	16.0	10.0	9.0

Table 4.2.2.3: Marks allotment for selected categories for comparison of E-learning Metadata Standard

In addition, the following table (4.2.2.4) is also helpful in analyzing and evaluating standards under study (QUIS Team, 2005). It shows different tools supported by different standards. The LOM standard mainly builds on the Dublin Core and is based on the recommendations of IMS and ARIADNE project. LOM metadata specification forms the basis of almost all existing implementations of metadata specifications for learning objects (Keenoy, 2003). It is also found that, SCORM does not directly author standards but pledges to adopt and make practical the best standards put forward by other groups. The SCORM specification combines elements

of IEEE, AICC and IMS specifications into a consolidated document that can be easily implemented. SCORM metadata includes IMS metadata and LOM metadata whereas IMS metadata includes LOM and Dublin Core (DC) metadata. ARIADNE defines elements that describe metadata for common e-Learning resources but does not define the form of this metadata. Their relationship is shown in Fig. 4.2.2.2.

Metadata Standard	Authoring Tools	Learning Management System (LMS)	Repositories
SCORM	5 free+ 8	14	3
IMS	5 free+4	05	3
LOM	2 free		
Dublin Core (DC)	9 free +2		
ARIADNE	1 free		1

Table 4.2.2.4: Additional parameters for comparison of E-learning Metadata Standards

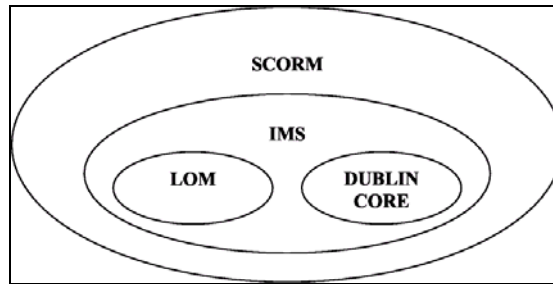


Fig. 4.2.2.2: Relationship of E-learning Metadata Standards

Among the e-Learning metadata standards the most popular one is IEEE Learning Object Metadata (LOM) (also known as IMS Learning Resource Meta-data) published by the Institute of Electrical and Electronics Engineers (IEEE) in 2002 supersedes the IMS Learning Resource Metadata specification (IMS Global Learning Consortium, 2013), which had been developed and used through several versions since the mid-1990s. The IEEE Learning Object Metadata (LOM) standard became the first accredited educational standard. IEEE-LOM aims to develop accredited technical standards, recommended practices, and guidelines for learning technology. It is the only officially approved standard for learning objects and has received widespread support from major players in the education technology industry.

After considering several projects and implementations concerning learning objects, the study concluded that IEEE-LOM is the best appropriate standard.

C. Selection of Metadata Schema for Theses and Dissertations

Various systems that contain metadata about theses and dissertations were analyzed. Finally three most popular metadata standards meant for theses and dissertations namely ETD-MS, UK-ETD, and Shodhganga (Indian) have been selected for evaluation having their differences in design, technical architecture etc. Here is a brief overview of selected schemas mentioned below -

C.1 ETD-MS

ETDMS was developed in conjunction with the NDLTD, and has been refined over the course of the last year. The initial goal was to develop a single standard XML DTD for encoding the full text of an ETD. ETDMS is based on the Dublin Core Element Set, but includes an additional element specific to metadata regarding theses and dissertations. Despite its name, ETDMS is designed to deal with metadata associated with both paper and electronic theses and dissertations. It also is designed to handle metadata in many languages, including metadata regarding a single work that has been recorded in different languages.

C.2 Shodhganga

The Indian ETD repository called Shodhganga (maintained by INFLIBNET) originated to facilitate open access to theses throughout the academic community. The word 'shodh' originates from Sanskrit and means research and discovery. Ganga is the name of the largest and holiest river in India. This project was intended to provide online accessibility to Indian theses, to ensure that they are easy to access and to create a place for them to be archived. It has developed and adopted a metadata standard called Shodhganga uses the qualified Dublin core set of elements for furnishing metadata in order to provide global access of Indian research outputs. The basic DC sets consists of 15 elements and the qualified set has about 31 elements in Shodhganga. A normal user or a researcher need not know about all metadata elements. The interface has been developed to incorporate essential values to be filled in by the user and rests of values are auto generated by system.

C.3 UK-ETD

This metadata standard is recommended by Electronic Theses Online Service (EThOS), UK. EThOS is the Electronic Theses Online System which allows individuals to find, access and archive doctoral e-theses that are produced in UK Higher Education institutions. Funding from the Joint Information Systems Committee (JISC) enabled three project teams in the UK to study the issues and challenges associated with the deposit and management of theses in electronic format. It was considered important to recommend a standard set of metadata elements to describe the contents of e-theses repositories. The schema was developed conforms to the guidelines for implementing Dublin Core in XML.

The following table (4.2.2.5) presents a comparison of three metadata schema against selected parameters. The table indicates the common data elements and compares the ETD-MS, UK-ETD and Shodhganga on the basis of pre-defined element sets. It is the union of the three previously mentioned metadata sets. The first column of the table lists the names of metadata elements, the second column describes the field name/metadata for ETDs (i.e. description/notes about metadata) and the last column shows method applied for the study.

Metadata elements	Field name/Metadata for ETDs	ETD-MS	UK-ETD	Shodhganga
dc.thesis.degree	Name of the degree to which thesis/dissertation is associated. For example MPhil/PhD	Y	N	N
thesis.degree.level	For example Master's, Doctoral, Post-Doctoral etc.	Y	N	N
thesis.degree.discipline	Name of the department e.g. Bengali, English, Library and Information Science etc	Y	N	N
thesis.degree.grantor	Name of the degree awarding University/Institution	Y	N	N
dc.rights.embargotype	Whether only campus access or part/section of the thesis/dissertation can be accessed	N	Y	N
dc.rights.embargodate	Embargo period i.e. date before which ETD may not be publicly available	N	Y	N
dc.rights.embargoreason	The reason of embargo e. g. applied for patent etc.	N	Y	N
dc.relation	If any other relation with the thesis	N	N	Y
dc.relation.isReferencedBy	The metadata 'jump off' page for the ETD at the institutional repository	N	Y	N

Metadata elements	Field name/Metadata for ETDs	ETD-MS	UK-ETD	Shodhganga
dc.relationhasVersions	Citations to previously published works related to ETD. If possible citation will be according to recognized standard	N	Y	N
dc.relation.references	References to other works	N	Y	N
dc.description.abstract	Abstract of the ETD	Y	N	Y
dc.description.note	ETD acceptance note of the department if any	Y	N	Y
dc.description.release	If any description of the version of the ETD	Y	N	N
dc.publisher	Name of the publisher as it appears on the title page of thesis/dissertation	Y	N	N
dc.publisher.department	Name of school, department, centre, faculty of the researcher	N	Y	N
dc.publisher.commercial	Name of the formal publisher of the thesis (If any)	N	Y	N
dc.publisher.place	Place of publication	N	N	Y
dc.publisher.university	Name of the degree awarding university	N	N	Y
dc.publisher.institution	Name of the degree awarding institution	N	Y	Y
dc.contributor	Name of the T/D supervisor(s)/guide(s)/advisors /committee member(s) etc.	Y	N	N
dc.contributor.role	Role of the person in creation the T/D e.g. Guide/Supervisor/Advisor/ Committee member etc.	Y	N	N
dc.contributor.sponsor	Sponsor of the researcher/student	N	Y	N
dc.contributor.release	If any errata published by researcher	N	N	Y
dc.contributor.guide	Name of the guide, repeatable in case of co-guide	N	N	Y
dc.date	Date appears on the title page of the T/D according to ISO 8601 standard	Y	N	N
dc.date.issued	Date appears on the title page (format yyyy-mm or yyyy) according to ISO8601	N	Y	N
dc.date.registered	PhD registration date	N	N	Y
dc.date.completed	PhD completion date	N	N	Y

Metadata elements	Field name/Metadata for ETDs	ETD-MS	UK-ETD	Shodhganga
dc.date.awarded	Date of PhD degree award (ISO 8601 format i.e. yyyy-mmdd)	N	N	Y
dc.type.qualificationlevel	Level of the degree (e.g. Diploma, Masters, Doctoral, Postdoctoral)	N	Y	N
dc.type.qualificationname	Name of the degree e.g. MPhil, PhD, DPhil	N	Y	N
dc.format.accompanying material	If any accompanying material released with thesis	N	N	Y
dc.format.dimensions	Size of the thesis	N	N	Y
dc.format.extent	Pagination for text, time duration in case moving image, file size in bytes for electronic file	N	N	Y
dc.format.medium	File format name (auto identified by the system)	N	N	Y
dc.format	File type or in which format T/D is appeared e.g. pdf, doc, html, odt etc.	Y	N	N
dc.identifier	This element used for URL of thesis/dissertation/ ID for physical objects i.e. in the case printed T/D	Y	Y	N
dc.identifier.URI	URL of the electronic thesis/ ID for electronic objects i.e. for ET/D	N	Y	Y
dc.identifier.thesis number	If any thesis number allotted by INFLIBNET Centre	N	N	Y
dc.identifier.handle	If any handle number provided by system	N	N	Y
dc.coverage	Time period or spatial area covered in thesis/dissertation	Y	N	Y
dc.source	If the thesis harvested from the Institutional / ETD repository	N	N	Y

Table 4.2.2.5: Comparison of Metadata Standards for Theses & Dissertations

All the formats (EDT-MS/UK-ETD/Shodhganga) under study are actually an extension of the Dublin Core format with new elements and provides guidelines for their (electronic thesis or dissertation) use in various environments. All these formats can be used for data exchange with various IRs in accordance with the OAI-PMH protocol. Therefore the migration of existing data from one system to another system is possible. It is expected that systems based on these proposed formats would increase the availability of theses and dissertations, and thus encourage the development of a knowledge-based society. UK-ETD has the following advantages:

- most comprehensive schema in the domain of ETD;
- frequency of updating is satisfactory;
- XML-encoded metadata standard;
- can be incorporated in various metadata models;
- supports cross resource discovery;
- using RDF (Resource Description Framework); and
- using Unicode.

As has hopefully become apparent in this comparative study, UK-ETD has been selected as metadata standard for theses and dissertations.

4.2.2.4 Metadata Harvesting

With the rapid advancement of both Web and database technologies, many organizations are realizing the benefits of placing their existing information systems online so that their employees, external users, and other organizations can make use of them in new and creative ways. Compounding this realization is the requirement that these resources must be accessible in a meaningful way both within and across various domains. The reality is that both technical and semantic inter-operability across resources is becoming paramount at a global level. Our field is not the exception. For example, many libraries around the world (OCLE, Library of Congress), each with their own independently developed database system, are now presenting their data through a uniform Web interface. As a result, a cross-library search for publications is now a reality. Even many digital repositories have some inbuilt mechanism to expose metadata using OAI metadata harvesting protocol. It is difficult for users to locate all needed works on a particular subject. There are no such mechanisms of metadata harvesting from different OAI-PMH compliant repositories containing variety of digital objects in different forms and formats. One important international movement to solve this problem is the Open Archives Initiatives (OAI). The Open Harvester Systems is a free metadata indexing system developed by the Public Knowledge Project through its federally funded efforts to expand and improve access to research. One of the most widely used metadata harvester software is the PKP Open Archives harvester. PKP Harvester (OAI harvester based search engine for digital repositories) is used to accumulate and index freely available metadata, providing a searchable, web-based interface.

In this particular section, four (4) most widely adopted interoperability approaches/standards have been described and compared in the field of integrating/harvesting metadata records in distributed digital libraries. This research study has developed a federated search mechanism for multiple OAI-PMH compliant OARs using PKP2 harvester (vide section 5.5 of chapter 5). In section 6.4 of chapter 6, mechanisms for browsing and searching OARs have been demonstrated through different screen snapshots.

4.2.2.4.1 Indian Scenario

Several prototypes cross search services based on metadata harvesting have already been established in the country (Hirwande & Hirwande, 2006; Hirwade & Bherwani, 2011). For example, the Search Digital Libraries (SDL), <http://drtc.isibang.ac.in/sdl/>, is a federated search service related to the Library and Information Science discipline. Search Engine for Engineering Digital-Repositories (SEED), <http://eprint.iitd.ac.in/seed/>, is a federated search service for the engineering discipline. A comprehensive federated search service for all the OA repositories in the country has not been attempted as yet. CASSIR (<http://smart.ncsi.iisc.ernet.in/oai>) is the first such attempt. It is an attempt to build and maintain metadata harvesting service for all the OA institutional repositories from India. It has been developed using the Open Harvester System (OHS), a FOSS metadata harvesting system developed by the Public Knowledge Project (PKP) to harvest the metadata.

4.2.2.4.2 Selection of Repositories for Metadata Harvesting

The main objective of this section is to present a method of metadata harvesting framework (using PKP2 harvesting software) that can harvest metadata from different OAI-PMH compatible OARs in order to provide global access to public funded research in a single-window search interface. The system has developed a prototype union catalogue of selected OARs as a single-window search interface to facilitate retrieval of OA resources on global scale. Here, authorized users can access resources of BURA as well as resources of others selected OARs through BURA interface. It (BURA) is a localized resource discovery service model that can harvest and update metadata from different OAI-PMH compliant OARs. This study includes 60 more large-scale OARs (based on carefully crafted parameters mentioned in Table 4.2.2.4.2) taking top ten (10) repositories from OpenDOAR database for each defined community in BURA. Repositories registered only in OpenDOAR database have been considered and repositories already selected for a particular discipline/subject have not been considered for another discipline/subject. The study has also taken into account all those repositories treated as multidisciplinary in nature because there are many subjects/disciplines (i.e. Bengali, Sanskrit) having no repository. The study has ignored many repositories (selected as per criteria mentioned in Table 4.2.2.4.2) due to the fact that they were not working and metadata index could not be updated at the time of harvesting due to some technical problems. The following table (4.2.2.4.2) shows the parameters on the basis of which OARs have been selected from OpenDOAR database for metadata harvesting.

Parameters	Conditions
Number of objects uploaded	Top ten OAR from OpenDOAR database for each defined community in BURA (objects may vary discipline to discipline)
Support for OAI-PMH (version 2)	Available for metadata harvesting
Type of software used	Distributed architecture
Language covered	English only
Data type	Textual (at least)
Data format	Variety of format supported
Data availability	Full text
Repository policy	Defined (at least one – see Table 4.2)
Web 2.0 compatible	Tools support/or Services available
Interface	Web-based
Searching	Simple and Advanced (at least)
Browsing and Sorting	Metadata elements
Metadata schemas	Open standard

Table 4.2.2.4.2: Parameters for selection of OARs from OpenDOAR Database

4.2.2.4.3 Selection of Metadata Harvesting Software

For the comparison of harvesting software, the study has considered several open source OAI harvesting tools like OAICat, Perl Tool, UIUC Java/ VB Harvester, DLESE, myOAI, ODL, etc. for ease of use, installation difficulty and robustness. Other harvesters were tested, but most were difficult to install. Most of them performed poorly with respect to installation ease are also explored. Most did not work out of the box. Finally the study has selected the following four (4) popular harvesting tools for comparison (Table 4.2.2.4.3) having their significant differences in their design, retrieval technique, underlying architecture and process. The following are the brief introduction of the harvesting software under study.

A. Arc

Arc is released under the NCSA Open Source License. Arc is a federated search service based on OAI-PMH. It includes a harvester, a search engine together with a simple search interface, and an OAI-PMH layer over harvested metadata. It can be configured for a specific community, and enhancements and customizations by the community are encouraged. Arc is based on Java Servlet technology and requires JDK1.4, Tomcat 4.0x, and a RDBMS server (tested with Oracle and MySQL).

B. DLESE

The DLESE OAI software supports the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH), v2.0. This is software version 2.0.9. This software is intended to be simple to set up and use. The data provider works by serving metadata collections that exist as XML files stored on disc. The software includes a number of search, validation and data viewing features to help support the creation and maintenance of metadata repositories. This software is provided under the GNU general public license.

C. OAICat

OAICat is a Java Servlet web application providing an OAI-PMH v2.0 repository framework. The framework can be customized to work with arbitrary data repositories by implementing some Java interfaces. It was developed by OCLC and was designed to work with data in its natural state. It can be customized to work with different metadata schemas in performing arbitrary operations on data harvesting by implementing some Java interface.

D. PKP2

The PKP Harvester2 is an opensource metadata harvester and aggregator that has been developed by the Public Knowledge Project through its federally funded efforts to expand and improve access to research. Harvester2 has been designed with flexibility in mind and supports multiple harvesting protocols and metadata formats with an emphasis on performance and simplicity of use. In concert with the PKP software suite, including Open Journal Systems and Open Conference Systems, the goal of Harvester2 is to promote open access publishing and contribute to the public good on a global scale. This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs License.

Parameters/Criteria	Metadata Harvesting Software			
	Arc	DLESE	OAICat	PKP
1. OS related				
1.1 Windows				
1.2 Unices				
1.3 Platform independent	Y	Y	Y	Y
1.4 Others				
2. Software architecture				
2.1 LAMP based				Y
2.2 Java based	Y	Y	Y	
2.3 Others				
3. Protocol related				
3.1 Santa Fee				
3.2 OAI/PMH ver 1.0	Y	Y	Y	Y
3.3 OAI/PMH ver 2.0	Y	Y	Y	Y
3.4 Others				
4. Harvesting process related				
4.1 Data provider-Service provider	Y	Y		Y
4.2 Aggregator	Y			
4.3 Others				
5. Harvesting administration				
5.1 Metadata schemas support	Multiple	Multiple	ETD-MS, DC	Multiple
5.2 User registration/creation	Y			Y
5.3 Independent archive manager				Y
5.4 Site submission by users				Y
5.5 Theme selection				
5.6 Layout design interface		Y		Y
5.7 Language interface selection				Y
5.8 Crosswalk creation				Y
5.9 Plug-in management		Y		Y
6. Retrieval related				
6.A Browsing facility				
6.A.1 Browsing by metadata elements		Y		Y
6.A.2 Sorting by metadata elements	Y			Y
6.B Searching				
6.B.1 Simple search	Y	Y	Y	Y
6.B.2 Advanced search	Y	Y	Y	Y
6.B.3 Field-level search	Y	Y		Y
6.B.4 Search operators support				Y
6.B.5 Control for display of results		Y		
6.B.6 Web 2.0 features	Y			Y

Table 4.2.2.4.3: Parameters for Comparison of Metadata Harvesting Software

In the end, this research study has selected PKP Harvester for the BURA software framework.

It (PKP) uses PHP, a standard web/database programming language, one that is easily integrated on the Apache Web Server under which DSpace runs along with the MySQL/PostgreSQL database and the Linux operating system. PKP Harvester is also open source, which allows us to freely modify the PKP application software. It is an excellent metadata harvesting and presentation tool. This multi-platform web-based tool extracts data and presents it in a coherent manner. It employs an intuitive user interface to organize data. Importantly, this OAI-PMH data provider software can handle various metadata formats and used an impressive GUI. The PKP Metadata Harvester allows for the creation of a customizable, searchable, online index of metadata available from Open Archives Initiative-compliant databases and information sources, including OJS journals and OCS conferences. The software has the following additional features/or advantages -

- Ability to harvest OAI metadata in a variety of schemas;
- Flexible search interface that allows simple searching and advanced searching using cross walked fields from all harvested archives;
- Ability to perform post-harvest and pre-indexing filtering/normalization on metadata; and
- Searching is highly scalable (creates an inverted index for searching).

4.2.3 Software (Basic Level)

The purpose of this section is to discuss different open source software required for developing a software framework. Obviously one software can not perform all the operations related to different sphere of activities. Therefore, the software framework requires creating a platform where different application software can be integrated in a seamless and harmonized manner to perform domain-specific jobs.

A. Platform

There is a number of operating system available in open source domain. The number of operating system support the software is examined. The tested operating systems (OS) are Windows, Linux, MacOSX, and Solaris. Ubuntu is a complete desktop Linux operating system, freely available with both community and professional support. It is up-to-date, very fast, easy to trial and install, easy to use, no viruses' threat, and secured. It is multilingual in nature and works brilliantly with a range of devices.

This research study has selected Ubuntu (version 12.04) for the software framework.

B. Web Server

Many Web servers are now available both from commercial and open source world but Apache Web server is the most popular Web server. It is generally recognized as the world's most popular Web server (HTTP server). It was originally designed for Unix servers, the Apache Web server has been ported to Windows and other network operating systems (NOS). It provides a full range of Web server features, including CGI (Common Gateway Interface), SSL (Secure Sockets Layer), and virtual domains. It also supports plug-in modules for extensibility. It is reliable, powerful, flexible comes with an unrestrictive license. It is highly configurable and extensible with third-party modules. It is free and can be customized by writing 'modules' using the Apache module API (application programming interface). It is developed by Apache Software Foundation.

The latest stable release of Apache Web server (2.4.4) is selected as Web server for BURA software framework.

C. Backend Database Management Software

For this study three most popular RDBMS (MySQL, Oracle and PostgreSQL) software have been discussed and compared on the basis of selected parameters.

C.1 MySQL

It is a relational database management system (RDBMS) that runs as a server providing multi-user access to a number of databases. MySQL is written in C and C++. MySQL works on many different system platforms, including AIX, BSDi, FreeBSD, HP-UX, eComStation, i5/OS, IRIX, Linux. MySQL is primarily an RDBMS and therefore ships with no GUI tools to administer MySQL databases or manage data contained within (<http://en.wikipedia.org/wiki/MySQL>). The latest stable release of MySQL (version 5.6.10) has been used for BURA software framework.

C.2 Oracle

The Oracle Database (commonly referred to as Oracle RDBMS or simply as Oracle) is an object-relational database management system produced and marketed by Oracle Corporation (http://en.wikipedia.org/wiki/Oracle_Database).

C.3 PostgreSQL

PostgreSQL, often simply Postgres, is an object-relational database management system (ORDBMS) available for many platforms including Linux, FreeBSD, Solaris, MS Windows and Mac OS X. It is released under the PostgreSQL License, which is an MIT-style license, and is thus free and open source software. As with many other open-source programs, PostgreSQL is not controlled by any single company - a global community of developers and companies develops the system (<http://en.wikipedia.org/wiki/PostgreSQL>). PostgreSQL is popular RDBMS with both open source and Web based application. It is extremely fast, stable RDBMS with million installations around the world. It supports UTF-8 and UTF-16 character encoding and completely Unicode-compliant. The table (4.2.3) shows a comparison of Oracle, MySQL and PostgreSQL databases in the context of selection of a DBMS for BURA. The following are the points of comparison (http://dcdapp11.cern.ch:8080/dcdb/archive/ttraczyk/db_compare/db_compare.html) of selected three DBMS.

SL. No.	Checkpoints / Parameters	MySQL	Oracle	PostgreSQL
1	Automatic generation of unique identifiers	Average	Very good	Very good
2	Multiuser access	Average	Very good	Average
3	Access control	Very good	Very good	Good
4	Backup copies	Average	Very good	Average
5	Data migration	Very good	Good	Very good
6	Portability of DBMS	Good	Very good	Good
7	Query optimization	Good	Very good	Good
8	Data size limits	Good	Very good	Average
9	Large objects in database	Good	Very good	Average
10	Access to multiple databases	Average	Very good	Average
11	Recovery	Average	Very good	Average
12	Standard interfaces	Good	Very good	Good
13	Interoperability with Web technology	Good	Very good	Good
14	Support for special data types	Poor	Very good	Average

Table 4.2.3: Comparison of Databases against selected Checkpoints

This research work has selected PostgreSQL (version 9.2.3) as backend RDBMS and MySQL (version 5.6.10) for metadata harvesting for BURA software framework.

D. Mail Transfer Agent

This research study has discussed and compared three popular mail servers namely Exim, Postfix and Sendmail.

D.1 Exim

It is a mail transfer agent (MTA) used on Unix-like operating systems. Exim is free software distributed under the terms of the GNU General Public License, and it aims to be a general and flexible mailer with extensive facilities for checking incoming e-mail (<http://en.wikipedia.org/wiki/Exim>). It is highly configurable; it has extensive and exhaustive documentation. It is designed to deliver email immediately, without queueing.

D.2 Postfix

It is a free and open-source mail transfer agent (MTA) that routes and delivers electronic mail. It is intended as a fast, easier-to-administer, and secure alternative to the widely-used Sendmail MTA. It is released under the IBM Public License 1.0 which is a free software licence (http://en.wikipedia.org/wiki/Postfix_software). It can handle large amounts of e-mail; can check the E-mail meta-information. It attempts to be fast and easy to administer and secure. It is compatible with the MTA sendmail.

D.3 Sendmail

It is a general purpose internetwork email routing facility that supports many kinds of mail-transfer and delivery methods, including the Simple Mail Transfer Protocol (SMTP) used for email transport over the Internet. Sendmail supports a variety of mail transfer protocols, including SMTP, ESMTP, DECnet's Mail-11, HylaFax, QuickPage and UUCP (<http://en.wikipedia.org/wiki/Sendmail>). The following table shows the comparison of three popular mail server agent on the basis of selected parameters mentioned below:

Mail Server Agent	Server OS support		Features				Storage		License
	Linux/Unix	Windows	SMTP	Webmail	IMAP	NNTP	Database	File system	
Exim	Y	via Cygwin	Y	N	N	N	Y	Y	Open Source/GPL
Postfix	Y	N	Y	N	N	N	Y	Y	Open source/IBM Public License
Sendmail	Y	N	Y	N	N	N	Y	Y	Open source/Sendmail License

Table 4.2.3.1: Comparison of Three Mail Servers

It is found that all of them can handle large amounts of mail; can interact with databases in many formats; have an extensive knowledge of the many SMTP variants in use; are not trivially exploitable; have the source code available in a free manner; have third-party documentation available; and have significant user communities. But for our study we have selected Postfix because Postfix community is very active. Online documentation is quite good but scattered. Postfix is compatible with Sendmail and it is more efficient than Exim but not to a noticeable degree even with very high load. Postfix has a strong emphasis on security, Postfix is quite flexible in its configuration file, but not to the extent of Exim (<http://lwn.net/Articles/196711/>). It is the only modern mailer which expressly aims to be general-purpose.

Finally, Postfix as mail transfer agent has been selected for BURA software framework.

E. Mail Delivery Agent

This study has discussed two popular mail delivery agents mentioned below and compared them on the basis of selected parameters.

E.1 Courier mail server

It is a mail transfer agent (MTA) server that provides ESMTP, IMAP, POP3, SMAP, webmail, and mailing list services with individual components. It is best known for its IMAP server component. Courier can function as an intermediate mail relay, between an internal LAN and the Internet, or perform final delivery to mailboxes. Courier uses maildirs as its native storage format and can also deliver mail to legacy mailbox files. Configuration files are in plain text format and may include Perl scripts. Courier can provide mail services for regular operating system accounts (http://en.wikipedia.org/wiki/Courier_Mail_Server).

E.2 Dovecot

Dovecot is an open source IMAP and POP3 server for Linux/UNIX-like systems, written primarily with security in mind. Dovecot primarily aims to be a lightweight, fast and easy to set up open source mail server. A mail server suite that includes a mail delivery agent (http://en.wikipedia.org/wiki/Dovecot_software). Dovecot can work with standard mbox, Maildir, and its own experimental native high-performance mbox formats. It is fully compatible with UW IMAP and Courier IMAP servers' implementation of them, as well as mail clients accessing the mailboxes directly. The table shows a comparison of two mail delivery agents mentioned below.

Mail Server	Server OS support		Features				Storage		License
	Linux/Unix	Windows	SMTP	Webmail	IMAP	NNTP	Database	File system	
Courier	Y	N	Y	Y	Y	N	N	Maildir	Open Source
Devecot	Y	Y	Y	N	Y	N	Y	Maildir, mbox, mbox	Open Source/ MIT & LGPL

Table 4.2.3.2: Comparison of Two Mail Delivery Agents

This research study has finally selected Dovecot/ Squirrel Mail (version 1.4.20) as mail delivery agent for BURA software framework.

4.2.4 Software (IDR Level)

One of the most important elements of repository planning is selecting the software system that best satisfies needs of the institution. These needs will be driven by each institution's contents policies and by the various administrative and technical procedures required to implement those policies.

A. CDSWare

CDSWare (<http://cdsware.cern.ch>) is maintained and made publicly available by CERN and supports electronic preprint servers, online library catalogs, and other web-based document depository systems. CERN uses CDSWare to manage over 450 collections of data, comprising over 620,000 bibliographic records and 250,000 full-text documents, including preprints, journal articles, books, and photographs. CDSWare was built to handle very large repositories holding disparate types of materials, including multimedia contents catalogs, museum object descriptions, confidential and public sets of documents, etc. Each release is tested live under the rigors of the CERN environment before being publicly released.

B. DSpace

DSpace (<http://www.dspace.org/>) is designed by MIT in collaboration with the Hewlett-Packard Company between March 2000 and November 2002. Version 1.1.1 of the software was released in August 2003. The system is running as a production service at MIT, and a federation comprising large research institutions is in development for adopters worldwide. DSpace architecture supports the participation of the schools, departments, research centers, and other units typical of a large research institution. As the requirements of these communities might vary, DSpace allows the workflow and other policy-related aspects of the system to be customized to serve the contents, authorization, and intellectual property issues of each. Supporting this type of distributed contents administration, coupled with integrated tools to support digital preservation planning, makes DSpace well suited to the realities of managing a repository in a large institutional setting.

C. Eprints

The University of Southampton develops the Eprints (<http://software.eprints.org/>) software for managing large institute oriented digital archive for scholarly objects. The first version of the system was publicly released in late 2000. The project was originally sponsored by CogPrints, but is now supported by JISC as part of the Open Citation Project and by NSF. Eprints worldwide installed base affords an extensive

support network for new implementations. The size of the installed base for Eprints suggests that an institution can get it up and running relatively quickly and with a minimum of technical expertise.

D. Fedora

The Fedora (<http://www.fedora.info/>) digital object repository management system is based on the Flexible Extensible Digital Object and Repository Architecture (Fedora). The system is designed to be a foundation upon which full-featured institutional repositories and other interoperable web-based digital libraries can be built. Jointly developed by the University of Virginia and Cornell University, the system implements the Fedora architecture, adding utilities that facilitate repository management. The current version of the software provides a repository that can handle one million objects efficiently. The system's interface comprises three web-based services: A management API that defines an interface for administering the repository, including operations necessary for clients to create and maintain digital objects; an access API that facilitates the discovery and dissemination of objects in the repository; and a streamlined version of the access system implemented as an HTTP-enabled web service.

E. Greenstone

Greenstone (<http://www.greenstone.org/>) is a suite of software for building and distributing digital library collections that provides a way of organizing information and publishing it on the Internet or on removable media (e.g., CD-ROM/DVD). It is produced by the New Zealand Digital Library Project at the University of Waikato, and is distributed as open source, multilingual software in cooperation with UNESCO and the Human Info NGO. It originated in 1996. The dissemination of educational, scientific and cultural information, and particularly its availability in developing countries, is central to UNESCO's goals, and appropriate, accessible technology is seen as a vital tool in this context. Greenstone is issued under the terms of the GNU General Public License.

F. OPUS (Online Publications)

This system (http://elib.uni-stuttgart.de/opus/doku/english/index_english.php) is being tested by various German universities, and further development now in the hands of the University of Stuttgart. It is not open source at present. It was created for research papers which are displayed to users in PDF format, using DC (Dublin Core) with an mSQL database (Universität Stuttgart 2003: About OPUS). Authors may upload several files for archiving, but must also create and upload a PDF for use in the system. (Universität Stuttgart 2003: Electronic Dissertations). OPUS does not appear to be open source.

4.3 Selection of IDR software for BURA

One of the most important elements of repository planning is selecting the software system that best satisfies needs of the institution. These needs will be driven by each institution's contents policies and by the various administrative and technical procedures required to implement those policies. This research study has selected following six (6) popular IDR software from the open source domain and compared against various parameters framed by OSI (Open Society Institute). Selection of required IDR software for BURA software framework is also based on the download statistics as reported in of Sourceforge. Sourceforge (2012) is the world's largest repository in the domain of open source software. It allows users/programmers to download required open source software (OSS) from the archive and also provides download statistics against OSS. As a result, download statistics of Sourceforge can also be used as popularity index for OSS under a particular category.

This research study has followed a methodology for comparison of IDR software for the IDR Cluster of BURA software framework. The steps are given below:

1. Visiting the websites of the selected software;
2. Downloading and Installation of software;
3. Identifying and selecting software features;
4. Comparing them with selected parameters on the line of OSI guidelines;
5. Preparing score sheet and ranking as per total score; and
6. Suggesting best software having maximum score.

The study has taken all the parameters and sub-parameters and modified those parameters into three major groups (Full support, Partial support and No support) for this evaluation. These divisions of number (e.g. 1 indicates full support, 0.5 represents partial support and 0 indicates non-availability of support) for each group ranging from 0-1 have been fixed as follows:

Categories	Marks Allotted
Full support	1
Partial support	0.5
No support	0

Table 4.3: Marks allotment for selected Categories for comparison of IDR Software

This research study has classified all the parameters and grouped all those parameters into 10 (ten) broad headings under which all the selected IDR software have been evaluated. The broad headings are mentioned below with explanation and additional note(s) is given below where required.

A. Software Features

This particular section has been examined on the basis of the five points and additional notes are given below⁷:

- a. Operating System (OS)
- b. Database
- c. Web Server
- d. Java Servlet Engine (JSE)
- e. Search Engine

Parameters / Checkpoints	Score (1= full support; 0.5= partial support; 0= no support)					
	CDSware	Dspace	Eprint	Fedora	GSDL	OPUS
Operating System (OS)	0.5	1	1	1	1	1
Database	0.5	1	0.5	1	0 (own DBMS, no backend RDBMS)	0.5
Web Server	0.5	1	0	0	1	1
Java Servlet Engine (JSE)	0	1	0	1	0	0
Search Engine	0.5 (Cdsware)	0.5 (Lucene)	0 (Not Available)	0 (Database oriented)	1 (MGPP, Lucene)	0.5 (htDig)
Total Score	2	4.5	1.5	3	3	3

Table 4.3.1: Software Features

B. System support

This particular section has been examined on the basis of the three points mentioned below:

- a. Bug track /feature request system
- b. Format support/ help desk
- c. Software wiki

⁷ 1 for supporting many OS; 0.5 for supporting more than one OS; 0 for supporting only one OS

1 for supporting many DBMS; 0.5 for supporting one DBMS; 0 if there is no third party DBMS

1 for supporting any one of existing Web Server; 0.5 supporting more than one Web Server; 0 supporting only one specific Web Server.

Parameters / Checkpoints	Score (1= full support; 0.5= partial support; 0= no support)					
	CDSware	Dspace	Eprint	Fedora	GSDL	OPUS
Bug track /feature request system	1	1	0	1	1	1
Format support/ help desk	0.5 (for fee)	0	0	1	1	0
Software wiki	0	1	0	1	1	0
Total Score	1.5	2	0	3	3	1

Table 4.3.2: System support

C. Contents Management: Metadata

This particular section has been examined on the basis of the six points mentioned below:

- Metadata schema
- Support for extended metadata
- Disallow metadata harvesting
- Add or delete metadata fields
- Set default values for metadata
- Support Unicode character set for metadata

Parameters / Checkpoints	Score (1= full support; 0.5= partial support; 0= no support)					
	CDSware	Dspace	Eprint	Fedora	GSDL	OPUS
Metadata schema	0.5 (Standard MARC21)	0.5 (Qualified Dublin core)	0.5 (Dublin Core)	0.5 (Dublin Core)	1 (Dublin core, Qualified Dublin core, AGLS,GILS)	0.5 (Qualified Dublin core)
Support for extended metadata	0	1	0	1	1	0
Disallow metadata harvesting	1	1	1	1	0	0
Add or delete metadata fields	1	1	1	1	1	1
Set default values for metadata	1	1	0 (Not assigned)	0	0	1
Support Unicode character set for metadata	1	1	1	1	1	0
Total Score	4.5	5.5	3.5	4.5	4	2.5

Table 4.3.3: Contents Management (Metadata)

D. Contents Management: Preservation

This particular section has been examined on the basis of the six points and additional notes are given below⁸:

- a. Models followed (CDR, HDR, MIT)
- b. Format support
- c. Approved file format function
- d. File format ingested
- e. Submitted items can comprise multiple files

Parameters / Checkpoints	Score (1= full support; 0.5= partial support; 0= no support)					
	CDSware	Dspace	Eprint	Fedora	GSDL	OPUS
Models followed (CDR, HDR, MIT)	1 (C)	1 (M)	1 (C)	1 (M)	1 (H)	1 (H)
Format support	0	1	1	1	1	0
Approved file format function	0	0	0	1	1	0
File format ingested	0.5 (3 rd party tool)	1	1	1	0	1
Submitted items can comprise multiple files	1	1	1	1	0	1
Total Score	2.5	4	4	5	3	3

Table 4.3.4: Contents Management (Preservation)

E) Contents Management: Contents export- import

This particular section has been examined on the basis of the three points mentioned below:

- a. Upload compressed files
- b. Volume import for objects
- c. Volume import for metadata

⁸CDSware and OPUS don't support proprietary software files like doc, ppt, while others support all. C stands for CDR, H stands for HDR and M stands for MIT model.

Parameters/ Checkpoints	Score (1= full support; 0.5= partial support; 0= no support)					
	CDSware	Dspace	Eprint	Fedora	GSDL	OPUS
Upload compressed files	1	0.5 (do not uncompress)	1	1	1	1
Volume import for objects	1	1	1	1	1	0.5 (require script modification)
Volume import for metadata	1	1	1	1	1	0.5 (require script modification)
Total Score	3	2.5	3	3	3	2

Table 4.3.5: Contents Management (Contents export-import)

F) Administration, Security and Management

This particular section has been examined on the basis of the seven points mentioned below:

- a. System assigned password
- b. User selected password
- c. Forgotten password function
- d. Edit user profile
- e. Limit Access by user type
- f. Multiple Authentication method
- g. Limit Access at file / Object level

Parameters / Checkpoints	Score (1= full support; 0.5= partial support; 0= no support)					
	CDSware	Dspace	Eprint	Fedora	GSDL	OPUS
System assigned password	1	1	0	0	1	1
User selected password	1	1	1	1	1	0
Forgotten password function	1	1	1	0	0	0
Edit user profile	1	1	1	0	0	0
Limit Access by user type	1	1	1	1	1	0
Multiple Authentication method	1	1	0	1	1	0
Limit Access at file / Object level	1	1	1	0	1	
Total Score	7	7	5	3	5	1

Table 4.3.6: Administration, Security and Management

G) Contents Submission Administration

This particular section has been examined on the basis of the two points mentioned below:

- a. Usage statistics
- b. Usage report

Parameters/ Checkpoints	Score (1= full support; 0.5= partial support; 0= no support)					
	CDSware	Dspace	Eprint	Fedora	GSDL	OPUS
Usage statistics	0.5 (uses third party tools)	1	0	1	0	1
Usage report	0	1	0	0 (planned)	0	1
Total Score	0.5	2	0	1	0	2

Table 4.3.7: Contents Submission Administration

H) Archiving

This particular section has been examined on the basis of the two points mentioned below:

- a. System assigned identifiers
- b. CNRI handles

Parameters/ Checkpoints	Score (1= full support; 0.5= partial support; 0= no support)					
	CDSware	Dspace	Eprint	Fedora	GSDL	OPUS
System assigned identifiers	1	1	1	1	0	1
CNRI handles	0	1	0	0	0	1(uses URN)
Total Score	1	2	1	1	0	2

Table 4.3.8: Archiving

I) User interface

This particular section has been examined on the basis of the two points and additional note is given below⁹:

- a. Supports multiple language interface
- b. Discussion forum support
- c. Dynamic interface change

Parameters / Checkpoints	Score (1= full support; 0.5= partial support; 0= no support)					
	CDSware	Dspace	Eprint	Fedora	GSDL	OPUS
Supports multiple language interface	1	1	1	1	1	0
Discussion forum support	1	1	1	1	1	1
Dynamic interface change	0	1	0	0	0	0
Total Score	2	3	2	2	2	1

Table 4.3.9: User Interface

J) Search capability

This particular section has been examined on the basis of the three points and additional notes are given below¹⁰:

- a. Full text
- b. Search all descriptive metadata
- c. Search selected metadata fields

Parameters/ Checkpoints	Score (1= full support; 0.5= partial support; 0= no support)					
	CDSware	Dspace	Eprint	Fedora	GSDL	OPUS
Full text	1	1	0	1	1	1
Search all descriptive metadata	1	1	1	1	1	1
Search selected metadata fields	1	1	1	1	1	1
Total Score	3	3	2	3	3	3

Table 4.3.10: Search capability

⁹All the software allows modifying user interface.

¹⁰All the software supports browsing by Author, Title, Issue date, Subject, Collections
All the software can display sort search result by author, title, issue date, subject, relevance, other

Table 4.3.11 shows the total score of selected software under study based on the above tables (4.3.1 to 4.3.10) and combining the entire tables (e.g. 4.3.1 to 4.3.10), it is found that Dspace has got the highest points (35.5) and ranks the 1st position. The final results are given below in Table 4.3.11.

Score / Points	CDSware	Dspace	Eprint	Fedora	GSDL	OPUS
Table 4.3.1 (Software Features)	2	4.5	1.5	3	3	3
Table 4.3.2 (System support)	1.5	2	0	3	3	1
Table 4.3.3 (Contents Management – Metadata)	4.5	5.5	3.5	4.5	4	2.5
Table 4.3.4 (Contents Management - Preservation)	2.5	4	4	5	3	3
Table 4.3.5 (Contents Management-export- import)	3	2.5	3	3	3	2
Table 4.3.6 (Administration, Security & Mgt.)	7	7	5	3	5	1
Table 4.3.7 (Contents Submission Administration)	0.5	2	0	1	0	2
Table 4.3.8 (Archiving)	1	2	1	1	0	2
Table 4.3.9 (User interface)	2	3	2	2	2	1
Table 4.3.10 (Search capability)	3	3	2	3	3	3
Total Score	27	35.5	22	28.5	26	20.5

Table 4.3.11: Score Sheet of selected IDR software against Parameters

It is clear from the study that all the six (6) software under study supports a few common features. This research study has selected only these six (6) IDR software having significant differences in their design, their underlying architecture and process and complexity for how they are implemented. Later, this study has simplified the parameters and evaluated the selected IDR software on the basis of selected criteria.

Actually the selection of software depends on the goals, objectives and requirements of the organization. Several studies proved that DSpace is more popular repository software than EPrints or Fedora. According to the DSpace home page (<http://www.dspace.org/whos-using-dspace>), more than 1500 institutions throughout the world have installed DSpace.

Another two popular databases (OpenDOAR & ROAR) support this view. OpenDOAR (http://roar.eprints.org/cgi/roar_graphic?cache=2465825) database shows that more than 41% institutions use DSpace. ROAR (http://roar.eprints.org/cgi/roar_graphic?cache=2465825) is in support by saying that more than 47% repositories use DSpace. And has the following advantages (<http://www.dspace.org/why-use>):

- Largest community of users and developers worldwide;
- Free open source software;
- Completely customizable to fit your needs;
- Used by educational, government, private and commercial institutions;
- Can be installed out of the box; and
- Can manage and preserve all types of digital content.

Our country is not the exception. Most of the institutions use DSpace as it is the least complex system and supports multiple objects with multiple file formats. It is a finished product. It allows users designing community based contents policies and makes submission processes easy. It supports long-term preservation of the digital objects stored in the repository. It has also a good development and support team (MIT & HP). Actually it has been designed to support submission, management and access of digital contents. After installation any organization can create communities, sub communities easily and have the freedom to design work flow pattern and other policies regarding e-person, metadata schema, withdrawal, intellectual property right issues etc. for each type of collection. It is best suited for its interoperability standard and security and can be accommodated in a national network.

Recommendation(s)

A set of recommendations are drawn regarding software selection for the system (BURA) on the basis of the discussion made in this particular section 4.3.

It can be summarized on the basis of the comparative study of DSpace with other selected IDR software against selected parameters framed by OSI guidelines shows that DSpace has all the features required to manage IDRs resources.

4.4 Clustering of the Model

The general architecture of the model BURA recommends unification of open source IR software in Web-enabled multilingual environment. The area is complex one and requires many supporting software. Therefore it is logical to distribute the whole tasks in various clusters in order to designing software framework for BURA. Each Cluster deals with specific tasks. The software framework of BURA is divided into three main Clusters keeping the features, components and architecture of the model. Table (4.4) shows the major activities of each Cluster.

Cluster	Major activities
Cluster-I (Basic Cluster)	<ol style="list-style-type: none"> 1. Storing, processing and retrieving of IDR resources 2. Development of Web-access environment 3. Design of common user interface 4. Searching and rendering services based on IDR resources 5. Development of programming environment
Cluster-II (IDR Cluster)	<ol style="list-style-type: none"> 1. Development of standard data entry framework for IR resources 2. Incorporation of vocabulary control device for standardization of data entry activities 3. Management and organization of communities and collections 4. Management of user registration, E-People selection and access privileges 5. Export and import of IR resources
Cluster-III (Multilingual Cluster)	<ol style="list-style-type: none"> 1. Storing, processing and retrieving Bengali language based resources 2. Bengali language based user interface 3. Searching and rendering services based of Bengali language

Table 4.4: Major activities of different Clusters

As a final point, list of selected open source software for each Cluster can be prepared on the basis of above discussions. The table (4.4.1) shows the software required for different Clusters of BURA software framework.

Major Clusters	Open Source Software
Cluster I: Basic Cluster	Apache Web server, PostgreSQL database management system, Java programming environment, MySQL, PHP, PERL
Cluster II: IDR Cluster	DSpace
Cluster III: Multilingual Cluster	Avro virtual keyboard, Bengali Open Type Fonts, Uniscribe Rendering Engine (USP10.DLL)

Table 4.4.1: List of Selected Open Source Software (latest stable release as on 31.07.2013) for BURA

4.4.1 Designing of Basic Cluster

The main purpose of the basic cluster is to create a web based environment where software from other four cluster be integrated to interact with each other. This cluster therefore requires four open source software or software groups namely operating system or platform, Web server, Backend Database Management Software and Mail server.

A. Web Server

Most of the commercial applications are developed using an Ethernet backbone in mind. Ethernet backbone connects multiple computers together on the network. In this type of framework the clients and server(s) are always connected to one another when switched on or active. This framework undergoes a huge change when the same multi-user applications are mounted on the Internet. Internet uses TCP/IP to connect computer across the network. TCP/IP does not permit the clients and server(s) being always connected. Therefore, when Internet or Intranet is used as a framework for connecting clients and servers, an application must run on client machines called Web browser (e.g. Mozilla Firefox, Netscape communicator, Internet explorer, Opera etc.) and other application must run on the server(s) called Web server. These two applications, Web server and Web browser, set up a link between them by using HTTP communication protocol and Request/Response paradigm. Many Web server are now available both from commercial and open source world but Apache, an open source Web server, is the world's most popular Web server (NUA, 1999). Apache HTTP Server Project is developed to design and implement an open source HTTP server for the modern operating systems including all the families of UNIX as well as Windows operating systems (Apache, 2011). Apache (A PAtChE sERver) is based on NCSA HTTPD developed by Rob McCool in 1994 (Apache Group, 2001) and available for many operating systems (Unices, Windows etc.). Apache was regarded as the only web server software to surpass the 100 million website milestone (NetCraft, 2009). In nutshell, statistics show that Apache web server has been the most promising and reliable web server till now. Recent study (Web Server, 2011) reveals that Apache has served over 59.13% of all websites and more than 66.62% of the million busiest ones. The latest stable release of Apache Web server (version 2.4.4) is selected as Web server for BURA software framework.

B. Backend Database Management Software

In the domain of database management systems, PostgreSQL stands out at an apex. It is a relational database management system that runs as a server providing multi-user

access to a number of databases within it. It offers many profiling tools to generate reports or profiles of the back-end databases. It also offers a superior protection to the database and uses strong authentication facilities while providing strong internal security algorithms. PostgreSQL, a hugely popular RDBMS (Relational Database Management System) with both open source and Web based application, can play this role efficiently for BURA software framework. This is the backend database of DSpace, which stores information about communities, collections, metadata etc. The latest stable release of PostgreSQL (version 9.2.3) is selected as backend RDBMS for the following reasons –

In addition MySQL, a hugely popular RDBMS with both open source and Web based application, is used for BURA software framework for the following reasons:

- Extremely fast, stable, open source;
- Supports UTF-8 and UTF-16 character encoding and completely Unicode-compliant;
- GUI based front-end tools are available for easy management of MySQL
- Runs on several operating systems; and
- Ideally suited for PHP, PERL due to the syntax support.

C. Scripting Language Programming Environment

Most of the FLOSS based Web-integrated database applications use Apache-PostgreSQL framework. However, proper programming environment are required to utilize the power and speed of Apache-PostgreSQL combination. In June 1991, a group of Sun Microsystems engineers led by James Gosling decided to develop a language for consumer devices (cable boxes, etc.). Java as a programming language developed by James Gosling in 1995 is a core component of Sun Microsystems' Java platform. The advantages of JAVA programming environment may be summarized as below -

- Java is portable, which means that computer programs written in the Java language must run similarly on any hardware/operating-system platform;
- JAVA is an open source programming environment, free to download and compatible with almost all web servers (Apache etc.);
- JAVA supports many database management systems;
- JAVA runs on different platforms (Windows, Linux etc.);
- Java is designed to make distributed computing easy with the networking capability that is inherently integrated into it;
- Java is object-oriented because programming in Java is centered on creating objects, manipulating objects, and making objects work together. This allows you to create modular programs and reusable code;
- Java was designed to be easy to use and is therefore easy to write, compile, debug, and learn than other programming languages; and
- Java contains multiple types of garbage collectors.

PERL (Practical Extraction Report Language) and PHP (Hypertext Pre Processor) are also two important and widely used open source programming environment. Programmes written in either PERL or PHP can run smoothly on any databases (e.g. MySQL or PostgreSQL). The two programming environments are very popular among CGI (Common Gateway Interface) programme developers. PERL was originally created to extract information from the text files and then use information to prepare reports. PERL is a scripting language, which means that a PERL script programme does not have to compile and link. Instead, PERL interpreter executes the PERL script.

PHP is a preprocessor for hypertext. Since it is a preprocessor, it runs at the Web server and preprocesses HTML codespec before it is dispatched to a client browser. The advantages of PHP programming environment may be summarized as below –

- PHP supports many database management systems;
- PHP is a parsed language and there is no requirement for compiled binaries;
- PHP is an open source programming environment; and
- PHP runs on different platforms.

This combination of Apache, PostgreSQL and JAVA can run on two most popular platforms namely Linux and Windows. It means BURA is powered by a perfect XAMP basic Cluster where other domain-specific software can interact with each other seamlessly and in an interactive way.

Finally, the Basic Cluster of BURA software framework uses Apache as Web server, MySQL and PostgreSQL as backend RDBMS and JAVA, PHP, PERL as programming environment.

4.4.2 Designing of IDR Cluster

A Web-based integrated IDR system has many advantages. Use of integrated IDR system helps in the application of sophisticated information organization techniques in storing, processing and retrieving of IDR resources. It is found that DSpace under Berkeley Software Distribution (BSD) license is the most popular IDR software developed by MIT in 2002. MIT proposed developing a new distributed system using open source tools (Apache, PostgreSQL, JAVA) that would run under Linux. DSpace is ideally suited for IDR Cluster of the BURA software framework for the following reasons –

- Based on XAMP (Linux/Windows, Apache, PostgreSQL, Java) and Web-centric architecture;
- Supports Z39.50, ISO-2709 protocol and based on global standard in relation to interoperability, network, export/import etc.;
- Allows easy and extensive customization of source code;
- Supports Qualified Dunlin Core standards (W3C approved);
- Allows simple and sophisticated searching;
- Provision for designing multilingual search interface for storing, processing and retrieving of regional documents;
- Allows administrator to add/edit/remove communities, sub-communities and collections and supports designing community based submission and contents policies within the system; and
- Supports distributed processing and distributed access of IDR resources from any work place.

DSpace (latest stable release 1.8.2 as on July, 2012) is thus selected as IR Cluster of the BURA software framework but can not be applied directly because of the following reasons -

- DSpace does not provide Bengali language based interface and therefore a theme is to be developed to support Bengali language based interface;
- Although all the software required to run DSpace (Apache, PostgreSQL, Java) allows universal character set, DSpace itself is not Unicode-compliant and therefore DSpace source code requires to be modified to allow processing of Bengali script based information objects;
- DSpace is not preloaded with any standard format to manage IDR resources; and
- DSpace is not integrated with vocabulary control device, code lists and standard lists required for standardized data entry activities for IR resources.

4.4.3 Designing of Multilingual Cluster

India has 418 languages of which 407 are living and 11 are extinct (Maitra, 2002). In India, less than 5% people can read and write English (Technology Development for Indian Languages Group, 2003). There are 22 constitutionally recognized languages written in a variety of scripts. Assamese, Bengali, Gujarati, Hindi, Kannada, Kashmiri, Konakani, Malayalam, Manipuri, Marathi, Nepali, Oriya, Punjabi, Sanskrit, Sindhi, Tamil, Telugu and Urdu are 18 major constitutionally recognized languages being represented by ten different scripts, i.e. Arabic, Devnagari, Bengali, Gurumukhi, Gujarati, Oriya, Tamil, Telugu, Kannada and Malayalam. One benefit from the database point of view is that one Indian script can represent a number of languages, for example Devnagari is the script used for several languages such as Bhojpuri, Bihari, Hindi, Kashmiri, Konkani, Marathi, Nepali and Sanskrit. Similarly, Bengali script is used to represent Bengali, Assamese, Chakma, Gar, Khasi, Meiti, Mundari, Naga, and Santali (Microsoft Bhasa, 2005).

A Encoding of Indic Script

With the progress of multimedia technology, many formats came into existence to deal with multimedia files. In July 1983, the Department of Electronics (DoE) announced Indian Standard Code for Information Interchange (ISCII), called ISCII-83, on the basis of ISO 8-bit recommendations. The DoE also brought out a keyboard standard for Indian scripts in 1986. There was a revision of ISCII code in 1988 (Bhatt, 2001). In November 1991, Bureau of Indian Standards (1991) adopted the ISCII code developed by the DoE as Indian standard. Technology Development for Indian Languages (TDIL) has been established by Ministry of Information Technology, Government of India, in 1991 to encourage local language computing sector. C-DAC (Centre for Development of Advanced Computing), a collaborative partner of TDIL and BIS, developed GIST (Graphics and Intelligence based Script Technology) card as a solution for managing Indian languages on DOS platform. GIST card helps in using scripts of Indian languages in various DOS based applications. Another related product is ISFOC (Indian Standard Font Code), which evolved for representing Indian scripts in GUI based applications (Prasad, 2003). One major problem of all these ISCII based solutions such as GIST card or ISFOC is that they use 1 Byte representation of characters. As only a maximum of 256 values can be stored, GIST card or ISFOC can handle one Indian script at a time. It means these technologies can work for creating bi-script databases – one Indian language in combination with English and cannot support the true multi-script environment.

During 1991, the Unicode Consortium and the International Organization for Standardization (ISO) recognized that a single, universal character code was highly desirable. A formal convergence of the two standards was negotiated, and they were merged into a single character encoding in January 1992 (Unicode Consortium, 2005). The present version i.e. Version 4.1 of the Unicode Standard is code-for-code identical to ISO/IEC 10646. This code-for-code identity holds true for all encoded characters in the two standards, including the East Asian (Han) ideographic characters. While modeled on the ASCII character set, the Unicode Standard goes far beyond ASCII's limited ability to encode only the upper- and lowercase letters A through Z. It provides the capacity to encode all characters used for the written languages of the world—more than 1 million characters can be encoded.

Like other Indic scripts, the Bengali is derived from ancient Brahmi script. The script is associated with many languages such as Bengali, Assamese, Manipuri and Sylheti. As per the latest data of Ethnologue (Grimes, 2004), Bengali language is currently the fourth most spoken languages in the world with roughly 207 million speakers. The language is mainly spoken in the Indian province of Paschim Bangha formally known as West Bengal and in Bangladesh. Bengali language etymologically belongs to the

Eastern Magadga branch of the Indo-European language family, along with Assamese, Oriya, and Maithili (Chatterjee, 1972). The alphabet of Bengali language is a syllabic cursive alphabet with 12 vowels and 52 consonants. All consonants have an inherent embedded vowel sound. Vowel can be expressed using a variety of options. They can be written as independent letters, or they can be expressed by using a variety of diacritical marks.

Unicode is a standard to represent universal character sets not the glyphs. Therefore, it is the responsibility of rendering engine and different fonts to represent Bengali scripts properly keeping in view rendering rules of Bengali script. The Bengali script block is placed in Unicode just after Devnagari script block. The codespace for Bengali script ranges from U+0980 to U+09FF in Unicode (Fig. 4.4.3). Unicode allocation of Bengali script is completely based on ISCII 1988. Analysis of Fig. 4.4.3 shows that in Bengali script block Independent vowels are placed from U+0985 to U+0994, Consonants are placed within U+0995 to U+09B9, Dependent vowel signs are given code point from U+09BE to U+09CB and digits are placed within U+09E6 to U+09EF. A few Unicode based input methods for Bengali scripts are given in Fig. 4.4.3.1.

	098	099	09A	09B	09C	09D	09E	09F
0		ঙ	ঔ	ঝ	ঞ		ঠ	ড
1	ঁ		ড		ঢ		ঢ়	ঞ
2	ং		ঢ	ণ	ত		থ	দ
3	ঃ	ঙ	ণ		ত		থ	দ
4		ঙ	ত		ত			
5	ত্র	ক	খ					ূ
6	ত্রা	খ	দ	শ			০	ৃ
7	ৄ	গ	ঙ	ষ	ে	ী	ূ	।
8	ঋ	য	ম	স	ৈ		ূ	ৄ
9	ঊ	ঙ		হ			ৃ	০
A	ঊ	চ	প				ৃ	ূ
B	ঋ	ছ	ফ		ো		ূ	
C	ৃ	জ	ব	়	ৌ	ড়	ড	
D		য়	ভ		়	ঢ	ণ	
E		ঞ	ম	া			ূ	
F	এ	ট	য	ি		য়	ূ	

Fig. 4.4.3: Bengali Script in Unicode

শব্দ	লেখন পদ্ধতিতে সংরক্ষণ	প্রথম বর্ণ	ফোনটিক পদ্ধতিতে সংরক্ষণ	প্রথম বর্ণ
কাজ	কাজ	ক	কাজ	ক
কোন	কোন	ে	কোন	ক
কোন	কোন	ে	কোন	ক

Unicode based Input I

ইনপুট	সংরক্ষণ ও প্রদর্শন
ক U+0995	কি U+0995 U+09BF
ক U+0995	কো U+0995 U+09CB

Unicode based Input II

শব্দ	ইনপুট	ইউনিকোড ভিত্তিক ইনপুট
কমল	ক ম ল	ক ম ল
কাজ	কাজ	কাজ
ক্লাস	ক্লাস	ক্লাস
ক্রান্তি	ক্রান্তি	ক্রান্তি
পাটন	পাটন	পাটন
প্রাণ	প্রাণ	প্রাণ

Unicode based Input III

Fig. 4.4.3.1: Unicode based Input of Bengali Script

Obviously, Unicode is not hardware or software. It allocates unique value to each character of the script and enables a single software product to process various characters from different scripts of the world. As a result, creation of multi-script

databases requires not only Unicode-compliant operating system (OS) and other application programmes but also a Virtual Keyboard to enter multi-script records, Open Type Font (OTF) to support extended character sets and layout features, and Rendering Engine to display script specific conjuncts and ligatures properly.

B FLOSS based Tools for Processing Indic Scripts

This research identifies following software tools to manage processing of Bengali script based information objects in a Unicode compliant multilingual environment (as it is not possible to cover all the Indic scripts in this space):

B.1 Virtual Keyboard

Avro virtual keyboard (Khan, 2006), an open source Windows based product of Omicron Lab, is selected for BURA software framework for following reasons -

- The latest stable release of Avro is completely compatible with the latest Unicode version i.e. Version 5.1;
- Preloaded with five keyboard layouts (Avro phonetic, Barnona, National, Unbijoy and Avro Easy) and allows customization of layout as per user requirements;
- Facilitates a variety of typing options such as direct typing, typing from clip board and through mouse;
- Supports phonetic typing on the basis of carefully crafted rules;
- Allows custom configuration of the keyboard behaviour; and
- Users can turn on/off Bengali number typing from Numpad. This feature is extremely useful for Spreadsheet or Database management.

B.2 Uniscribe Rendering Engine

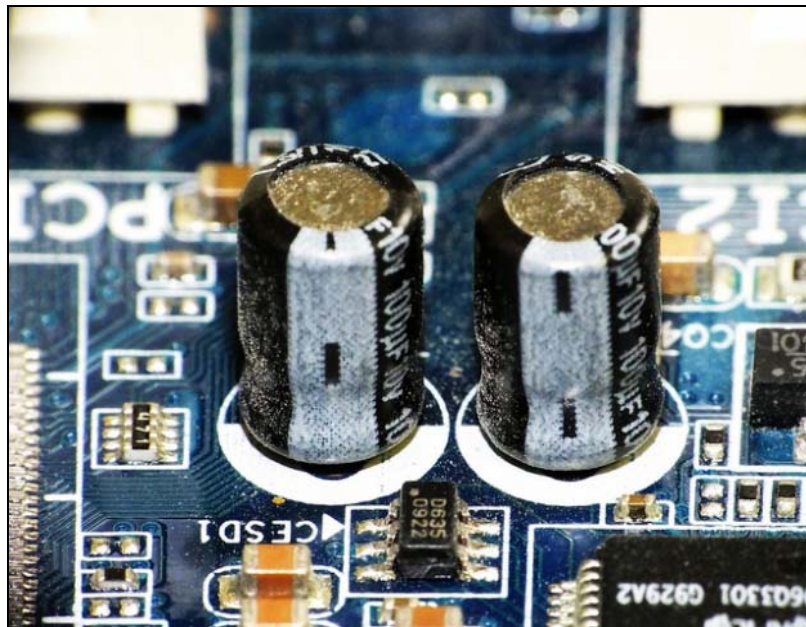
Conjuncts and ligatures are the most font dependent of any scripts. They could be at different positions in different fonts. Uniscribe, which is called a rendering engine, should be using each font's glyph substitution tables to contextually render the characters. One Uniscribe engine, called USP10.DLL, is available as freeware to display properly open type Indic fonts on Windows operating system. A modified version of USP10.DLL, which is compatible with Unicode 4.0, has already been developed by Ekushey Project (2004) and available from the project website as free download (http://egroups.com/group/ekushey/files/Uniscribe_Engine/usp.zip). This model is thus selected USP10.DLL Uniscribe engine for exact rendering of Bengali script in the software framework.

B.3 Open Type Fonts

An open type font has two distinct advantages in a multilingual environment- its cross-platform compatibility and its ability to support widely expanded character sets and layout features. Open type fonts provide richer linguistic support and advanced typographic control such as glyph positioning, multi-script baselines, substitutional positioning, glyph classification and attachment, ligature definition and decomposition etc. A series of Bengali open type fonts are produced by three Bengali language computational projects namely BengaliLinux of AnkurBangla Project (2003), Free Bangla Fonts Project (2004) or FBFP and Ekushey Project (2005). These are available for free downloading and includes Unicode-compliant fonts like Akash, Likhan, Mitra, Rupali etc (from AnkurBangla Project), Bangla, Ekushey Azad, Ekushey Durga, Ekushey Godhuli, Ekushey Mohua, Ekushey Sumit etc. from FBFP and Ekushey Project. All these fonts support Unicode 4.1 standard and USP10.DLL Uniscribe rendering engine, and thereby can be used in BURA software framework.

Chapter 5

Development of BURA: Software and Standards



“Technology is dominated by two types of people: those who understand what they do not manage and those who manage what they do not understand.”

Archibald Putt

Structure

- 5.0 Introduction
- 5.1 Design of Software Framework
- 5.2 Design of Multilingual Interface
- 5.3 Design of Submission Interface
- 5.4 Development of Subject Access Control
- 5.5 Development of Federated Search System
- 5.6 Incorporation of User Interaction Tools
- 5.7 Back up and Restoration Process
- 5.8 Development of ISO image

5.0 Introduction

This chapter aims to develop a software framework to support Web-enabled and Unicode-compliant IDR system for the University of Burdwan based on open standards and open source software (OSS) architecture. It has already been decided that the system should use open standard as far as feasible and should have ability to integrate with the other interoperable OAR system in order to harvest resources. This chapter describes how to make Bengali/Hindi language based user interfaces for storing, processing and retrieving Bengali/Hindi language based resources. This software framework allows searching and browsing of Bengali/Hindi languages based resources and renders services based on Bengali/Hindi languages. As it is not possible to produce here all the programmes in textual form due to space limitation, the programmes are given in the accompanying CDROM with proper indexes. This chapter is concerned with the development of librarian interface as well as user interface of the software framework and is available in Bengali script (along with English language interfaces). This is the management layer (librarian interface) of the model (BURA) through which librarians can perform various professional and administrative operations such as organization of resources under community and sub-community, managing of user registration, E-People selection and privilege control, management of interaction tools, import and export of resources etc. The success of user interfaces of the model (BURA) largely depends on this administrative (librarian) interface. The chapter is also concerned with the designing and development of a metadata harvesting framework using PKP harvester that will harvest metadata from different OAI-PMH compliant repositories and thereby ensures a federated search interface for end users. Several parameters have been framed for selecting repositories from OpenDOAR database and a comparative study of different harvesting tools has been conducted for selecting the most comprehensive harvester. This chapter reports applications of controlled vocabulary device to browse and search specific subject in BURA software framework. The subject access system of BURA also supports indexing, searching and browsing of resources in Bengali. This chapter also shows integration of selected social networking software like Blog, RSS in BURA software framework. Finally a ready-to-use product has been developed to help fellow professionals in implementing IDR in their respective institute without reconfiguring the system.

5.1 Design of Software Framework

The open source software of the Cluster - 1 (Basic Cluster) must be installed and linked properly before installation of software of other Clusters. Installation of Apache, MySQL, PostgreSQL, JAVA, PERL, and PHP is quite easy and straightforward in Linux operating system but their seamless linking is bit tricky. This

seamless linking of software in Basic Cluster (Cluster I) is must for developing the environment where all the software in different Clusters including community communication tools can interact with each other impeccably. So customization in DSpace (IDR Cluster) is required for the following reasons –

- Multilingual information processing and retrieval;
- Translation in Indic script base languages (here Bengali script);
- Incorporation of social networking software;
- Designing and development of metadata harvesting framework; and
- Incorporation of metadata schemas for managing special type of documents (like ETD, learning objects etc.).

The development process of IDR Cluster in BURA software framework involves following major steps –

- Step 1:** Integration of Basic Cluster with IDR Cluster in the software framework so that administrator can use and access IDR Cluster as a separate module in Basic Cluster;
- Step 2:** Preparation and management of community, sub-community and collection of BURA resources as prescribed in section 4.2.1.2 of chapter 4 along with their Bengali language equivalent;
- Step 3:** Developing controlled vocabulary device in Bengali in order to support indexing, browsing and searching specific subject categories;
- Step 4:** Designing and development of a metadata harvesting framework in IDR Cluster of the Model (BURA) using selected harvester (as proposed in section 4.2.2.4.3 of chapter 4);
- Step 5:** Enhancement of IDR Cluster by integrating selected social networking software like Blog, RSS in BURA software framework;
- Step 6:** Development of maintenance, backup and restoration procedures; and
- Step 7:** Preparation of ISO image file for porting BURA framework to help installing in other libraries.

DSpace has been selected for building IDR Cluster of BURA (see section 4.3 of chapter 4). DSpace itself is not Unicode-compliant but all supporting software necessary for running DSpace support universal character set. Therefore, the first task is to make DSpace Unicode-compliant for supporting Bengali script (both interface and processing of records). This research work deals with this programme level task

without changing the original source code of DSpace. It develops two Unicode-compliant themes – one for librarian interface and another for user interface. Librarian or the person responsible for managing IDR Cluster can select any of these themes by setting language preferences in browser (e.g. Mozilla Firefox). This is the management layer of BURA through which repository manager can perform various professional and administrative operations such as organization of resources under different community, sub-community and collection, management of community communication and interaction tools like RSS, Blog. However, it is possible to go back to default themes of DSpace at any time. It includes all the modules necessary for repository management activities as well as administrative operation.

a) Linking of Apache with PERL and PHP

The configuration file of Apache (httpd.conf) is modified to link PERL programming environment with Apache server. It is required to develop application environment for additional software in basic IDR framework such as Blog software and harvesting software.

Apache Environment	
Variable	Value
HTTP_HOST	localhost
HTTP_USER_AGENT	Mozilla/5.0 (X11; U; Linux i686; en-US; rv:1.9.2.20) Gecko/20110805 Ubuntu/10.04 (lucid) Firefox/3.6.20
HTTP_ACCEPT	text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
HTTP_ACCEPT_LANGUAGE	bn,es;q=0.8,en;q=0.5,en-us;q=0.3
HTTP_ACCEPT_ENCODING	gzip,deflate
HTTP_ACCEPT_CHARSET	ISO-8859-1,utf-8;q=0.7,*;q=0.7
HTTP_KEEP_ALIVE	115
HTTP_CONNECTION	keep-alive
PATH	/usr/local/bin:/usr/bin:/bin
SERVER_SIGNATURE	<address>Apache/2.2.14 (Ubuntu) Server at localhost Port 80</address>
SERVER_SOFTWARE	Apache/2.2.14 (Ubuntu)
SERVER_NAME	localhost
SERVER_ADDR	:::1
SERVER_PORT	80
REMOTE_ADDR	:::1
DOCUMENT_ROOT	/var/www
SERVER_ADMIN	webmaster@localhost
SCRIPT_FILENAME	/var/www/bijan/test.php
REMOTE_PORT	51938
GATEWAY_INTERFACE	CGI/1.1
SERVER_PROTOCOL	HTTP/1.1

Fig. 5.1: Apache and PERL Linking in Basic Cluster

Similarly, the file (httpd.conf) can be modified to link PHP programming environment with Apache server.

PHP Version 5.3.2-1ubuntu4.9	
System	Linux bijan-laptop 2.6.32-33-generic #72-Ubuntu SMP Fri Jul 29 21:08:37 UTC 2011 i686
Build Date	May 3 2011 00:31:05
Server API	Apache 2.0 Handler
Virtual Directory Support	disabled
Configuration File (php.ini) Path	/etc/php5/apache2
Loaded Configuration File	/etc/php5/apache2/php.ini
Scan this dir for additional .ini files	/etc/php5/apache2/conf.d
Additional .ini files parsed	/etc/php5/apache2/conf.d/curl.ini, /etc/php5/apache2/conf.d/gd.ini, /etc/php5/apache2/conf.d/ldap.ini, /etc/php5/apache2/conf.d/mysql.ini, /etc/php5/apache2/conf.d/mysqli.ini, /etc/php5/apache2/conf.d/pdo.ini, /etc/php5/apache2/conf.d/pdo_mysql.ini, /etc/php5/apache2/conf.d/xmlrpc.ini
PHP API	20090626
PHP Extension	20090626
Zend Extension	220090626
Zend Extension Build	API220090626,NTS
PHP Extension Build	API20090626,NTS
Debug Build	no
Thread Safety	disabled

Fig. 5.1.1: Apache and PHP Linking in Basic Cluster

b) Linking of MySQL with PERL and PHP

Interaction of PHP and PERL with MySQL is necessary to retrieve data from databases (Blog database and Harvester database). Generally, both PHP and PERL language pack includes linking instructions in the configuration file by default. PHP does it through php.ini file and PERL sets the link through DBI module

(DBD::mysql). The testing of link between PHP and MySQL is shown through two screen snapshots (Fig. 5.1.2 & Fig. 5.1.3).

mysql		
MySQL Support	enabled	
Active Persistent Links	0	
Active Links	0	
Client API version	5.1.41	
MYSQL_MODULE_TYPE	external	
MYSQL_SOCKET	/var/run/mysqld/mysqld.sock	
MYSQL_INCLUDE	-I/usr/include/mysql	
MYSQL_LIBS	-L/usr/lib -lmysqlclient_r	
Directive	Local Value	Master Value
mysql.allow_local_infile	On	On
mysql.allow_persistent	On	On
mysql.connect_timeout	60	60
mysql.default_host	no value	no value
mysql.default_password	no value	no value
mysql.default_port	no value	no value
mysql.default_socket	/var/run/mysqld/mysqld.sock	/var/run/mysqld/mysqld.sock
mysql.default_user	no value	no value
mysql.max_links	Unlimited	Unlimited
mysql.max_persistent	Unlimited	Unlimited
mysql.trace_mode	Off	Off

Fig. 5.1.2: Linking of MySQL with PERL and PHP for DSpace

After successful integration of MySQL and PHP, the web access shows the result:

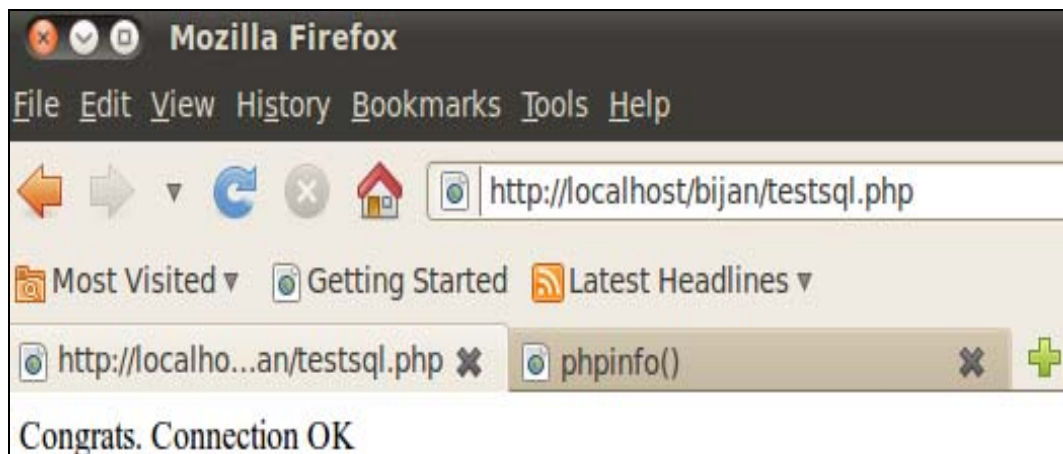


Fig. 5.1.3: Connection setting of MySQL in Basic Cluster

5.2 Design of Multilingual Interface

Contents creation in local languages is one of the most vital issues in any digital library system. It is necessary for promoting internet use, empowerment of the masses and to preserve cultural heritage and social identity. Therefore, the model BURA, recommends Bengali/Hindi language based interfaces (vide section 4.2.1.8 & 4.2.1.14 of chapter 4) and contents development in Bengali/Hindi languages in a multilingual environment. The development process of Multilingual Cluster (Cluster III) in BURA software framework involves following major steps –

- Step 1:** Development of Multilingual Cluster for BURA i.e. performing necessary programme level modifications of DSpace to make it Unicode compatible;
- Step 2:** Development of Multilingual Cluster in the software framework so that librarian can access and use Bengali script based interface for managerial activities;
- Step 3:** Development of Multilingual Cluster in the software framework so that end users can access Bengali script based interface for retrieval activities like browsing, simple searching and advanced searching;
- Step 4:** Designing and developing communities, sub-communities, collections, preparation of categories and sub-categories of BURA resources and other administrative works (as prescribed in section 4.2.1.2 of chapter 4) along with their Bengali language equivalent;
- Step 5:** Development of user registration form in Bengali script, password authentication mechanism and associated help file to ease the job of user registration (vide section 6.3 of chapter 6); and
- Step 6:** Developing controlled vocabulary device in Bengali in order to support searching and browsing specific subject category in Bengali language.

5.2.1 Multilingual Data Entry

Data entry activity in this BURA software framework is thus quite an easy job as it is supported by a number of data standardization tools. However, multilingual data entry works by the application of tools from Multilingual Cluster (Cluster III) of software framework requires special mention. It shows and explains use of Unicode-

compliant tools in entering Bengali script based records into the IDR cluster of the software framework. The virtual keyboard (Avro) of the framework can be invoked and to Bengali script entry mode simply by pressing F12 function key or from system tray icon of Avro (Khan, 2006) in Windows client. System manager can display of the Bengali script keyboard easily from system tray icon to enter Bengali script based data into the framework. At any point of time system manager can go to the default English language keyboard mode by pressing F12 function key again or by closing the Avro top bar in Windows client. The next step in developing application environment is to install and configure open source software of Cluster III (Multilingual Cluster) i.e. Avro virtual keyboard, USP10.DLL rendering engine and Open type fonts for Bengali script for Windows client. Presently rendering of Indic scripts in Linux (Fig. 5.2.0) is available readily for all Indic scripts (for example Ubuntu LTS 12.04 allows selection of any Indic script for the purpose of native script, interface and data entry works).

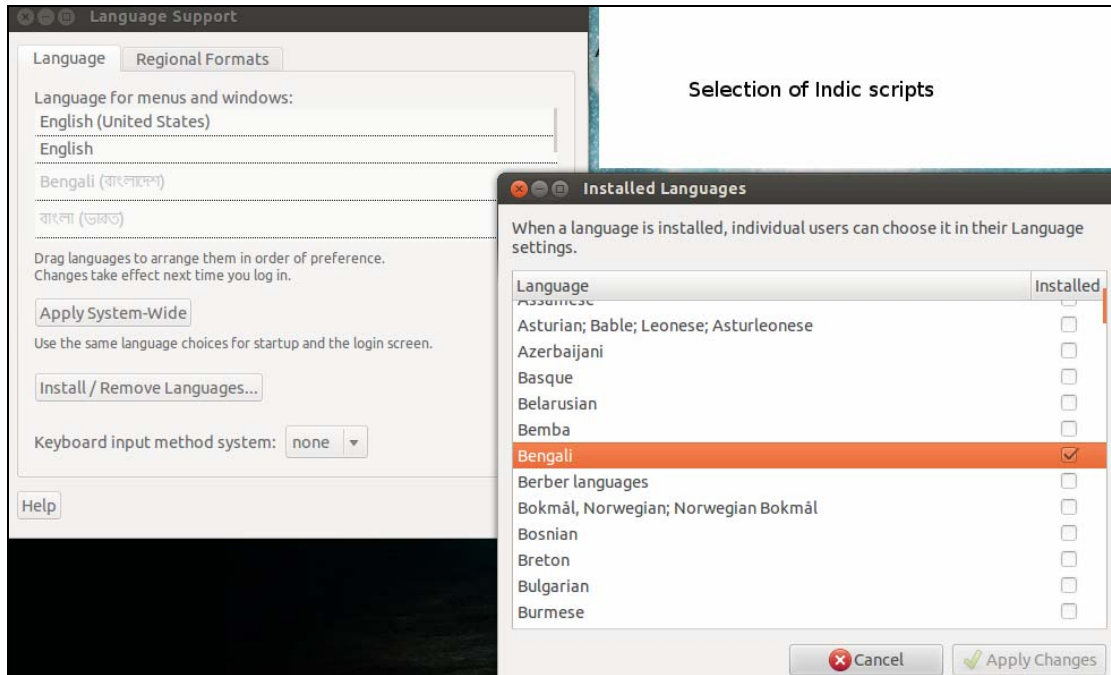


Fig. 5.2.0: Language selection in Ubuntu LTS 12.04

Entering Bengali script based data into Linux server through Windows client may also be done by submitters and end users. The Avro keyboard supports three mode of typing – direct typing by using layout (5 layouts are available), phonetic typing and click and type facility i.e. typing through mouse. Direct typing can be invoked either by pressing the F12 function key or by clicking the system tray icon of Avro keyboard. The following screen snapshots show the layout of Avro virtual keyboard (Fig. 5.2.1); click and type interface of the Avro virtual keyboard (Fig. 5.2.1.1) and layout Google Online Translator keyboard (Fig. 5.2.1.2). Avro adopted ‘UniBijoy

Keyboard Layout, which is actually a modified version of ‘*Bijoy Keyboard Layout*’. There are some major differences of key locations between these two layouts and moreover, ‘*UniBijoy Keyboard Layout*’ is phonetic whereas ‘*Bijoy Keyboard Layout*’ is symbolic in architecture.



Fig. 5.2.1: Layout of Avro Virtual Keyboard



Fig. 5.2.1.1: Click on Type Interface of Avro Virtual Keyboard

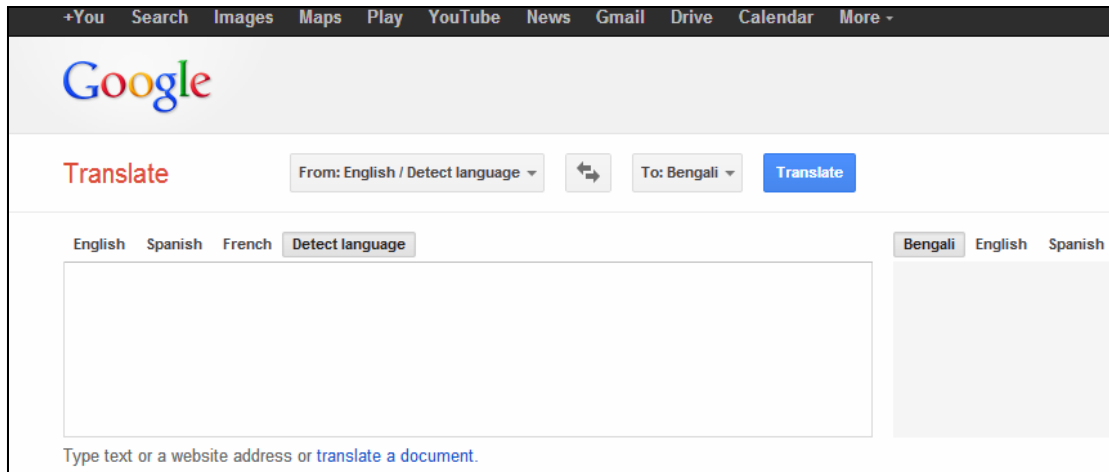


Fig. 5.2.1.2: Layout of Google Online Translator

5.2.2 Multilingual Features

Multilingual support is a relatively new phenomenon in digital library environment and one of the goals that BURA has been designed to pursue is to allow multilingual support in the easiest possible way. So the system is expected to be Unicode compliant and fully multilingual in nature in order to support processing and retrieving different regional languages. This section presents a method of information harvesting and consolidation to support the multilingual information requirements for cross-language information retrieval within digital repository systems. So, it is vital to implement a multilingual interface (e.g. User-interface in Bengali & Hindi) for a digital knowledge repository (BURA) to increase the world-wide potential for access to public funded research output.

DSpace is an excellent institutional repository system for archiving digital objects in a variety of formats. It, as open source sophisticated institutional repository software, can be customized extensively to develop Indic script based IDR on different subjects. It supports multiple languages in the user interface, in the metadata fields and in the digital contents. The Unicode Standard is the universal character-encoding scheme for written characters and text. It defines a consistent way of encoding multilingual text that enables the exchange of text data internationally and creates the foundation for global software. In the beginning Unicode was a simple, fixed-width 16 bit encoding. Over the time, Unicode changed this fixed-width encoding style and presently allows three different forms of encoding to meet different requirements.

- UTF-8 attempts to allow legacy systems to use Unicode by coding the characters in the ASCII character set with only eight bits, and encoding characters that are not in the ASCII character set with 16 bits. This is commonly used for Web pages.

- UTF-16 is supplementary characters outside the basic multilingual plane. It encodes most of the world's major languages in a fixed 16-bit character representation (2 bytes). This is the most common implementation.
- UTF-32 is an actually UCS 4, given a new name. It uses four bytes (32 bits) to encode all possible characters (rarely used).

5.2.3 Bengali Script based User Interface

Developing a user interface for IDR is not as easy as users are not geographically bounded. User interface of an IDR system demands more functionalities because such a system needs to support not only information retrieval but also submission, community communication and interaction and other administrative operations such as community creation, E-person management etc. In India, another requirement for user interface is its availability in local language. Therefore design of a Bengali language based interface (as proposed in section 4.2.1.8 & 4.2.1.14 of chapter 4) by following established design standards and incorporating easy-to-use search engine that has different levels of search sophistication can contribute greatly in success of BURA. This layout is designed in view of barriers like lack of contents in local language, a low rate of literacy and lack of necessary ICT skills among general users. The interface has the following characteristics -

- Provides a friendly and interactive interface to enable users to navigate effortlessly through the IDR system;
- Supports universal character set or in other words helps in contents development and contents access in Unicode-compliant Bengali script;
- Allows integrated browsing and searching in multilingual environment and dissemination of multiple media such as text, audio, video objects etc;
- Provides to access community communication tools (like E-mail, Instant messenger) and community interaction tools (like Blogs, Discussion forum);
- Allows to create Community and Sub-community, E-People, user registration;
- Allows to organize resources under community and sub-community and by using standard subject access system;
- Provides access and submission of dissertations, theses and other educational objects; and
- Allows easy submission of objects of different forms and formats by authorized users.

5.2.4 Bengali Script based Digital Repository through DSpace

Bengali script based IDR system on DSpace has been developed by the application of different open source software for the University of Burdwan. As PostgreSQL (the backend RDBMS for DSpace) supports UTF-8, the Bengali language based records can be retrieved and exhibited directly by using suitable GUI interface of PostgreSQL. Design of Bengali script based user interface, searching and browsing

mechanisms in DSpace requires three steps to be performed in logical sequence and is demonstrated here through three screen snapshots (Fig. 5.2.4 through Fig. 5.2.4.4).

Step 1

The first logical step of designing Indic script based user interface is making UTF-8 as default character encoding scheme or native character set for DSpace database in PostgreSQL RDBMS (Fig. 5.2.4). This step maintains a link between BURA software framework and the database used by the system.

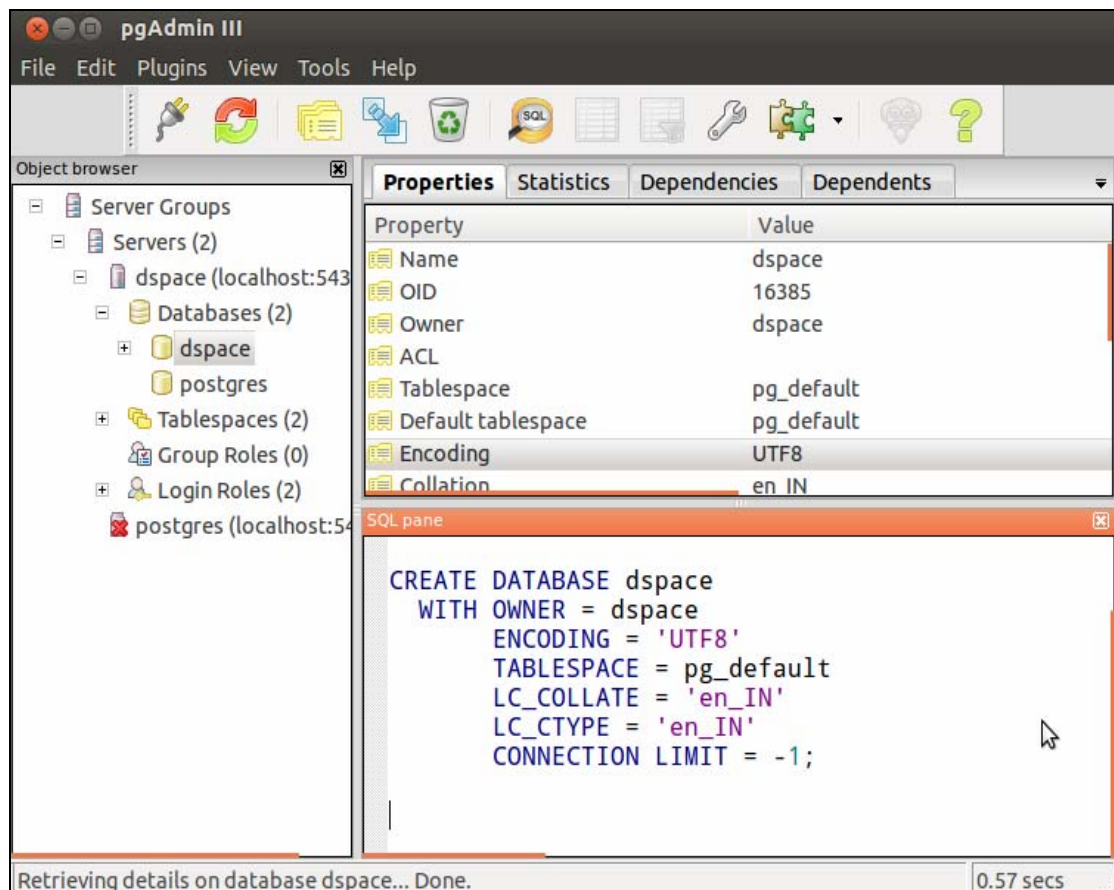


Fig. 5.2.4: DSpace database with UTF-8 as native character set

Step 2

Making necessary changes and translations of messages (from English to Bengali) in Message.properties file (available in the location - /webapps/dspace/WEB-INF/classes/Message.properties) is the next logical step to make the default interface in Bengali script. The following figure (5.2.4.1) shows the English language messages for *Submission Aspect* section of DSpace.

```

Submission Aspect

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!-->

<!-- general submission aspect messages -->
<message key="xmlui.Submission.general.mydspace_home">MyDSpace Home</message>
<message key="xmlui.Submission.general.go_mydspace">Go to MyDSpace Home</message>
<message key="xmlui.Submission.general.submission.title">Item submission</message>
<message key="xmlui.Submission.general.submission.trail">Item submission</message>
<message key="xmlui.Submission.general.submission.head">Item submission</message>
<message key="xmlui.Submission.general.submission.previous">&lt; Previous</message>
<message key="xmlui.Submission.general.submission.save">Save & Exit</message>
<message key="xmlui.Submission.general.submission.next">Next &gt;</message>
<message key="xmlui.Submission.general.submission.complete">Complete submission</message>
<message key="xmlui.Submission.general.workflow.title">Item submission</message>
<message key="xmlui.Submission.general.workflow.trail">Item submission</message>
<message key="xmlui.Submission.general.workflow.head">Item submission</message>
<message key="xmlui.Submission.general.showfull">Show full item record</message>
<message key="xmlui.Submission.general.showsimple">Show simple item record</message>
<message key="xmlui.Submission.general.default.title">Submission</message>
<message key="xmlui.Submission.general.default.trail">Submission</message>

<!-- org.dspace.app.xmlui.submission.CollectioViewer -->
<message key="xmlui.Submission.CollectionViewer.link1">Submit a new item to this collection</message>

<!-- org.dspace.app.xmlui.submission.Navigation -->
<message key="xmlui.Submission.Navigation.submissions">Submissions</message>

```

Fig. 5.2.4.1: Original Message File in English (Submission Aspect)

This default message property file has been translated in Bengali by using carefully translated message headings through the use of Unicode-compliant text editor. The figure (5.2.4.2) below shows the Bengali equivalents of English language messages for *Submission Aspect* section of DSpace.

```

Submission Aspect

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!-->

<!-- general submission aspect messages -->
<message key="xmlui.Submission.general.mydspace_home">আমার ডিস্পেস হোমপেজ</message>
<message key="xmlui.Submission.general.go_mydspace">আমার ডিস্পেস হোমপেজ যান</message>
<message key="xmlui.Submission.general.submission.title">তালিকাভুক্ত বিষয়ের দাখিন</message>
<message key="xmlui.Submission.general.submission.trail">তালিকাভুক্ত বিষয় দাখিন করুন</message>
<message key="xmlui.Submission.general.submission.head">তালিকাভুক্ত বিষয় দাখিন করুন</message>
<message key="xmlui.Submission.general.submission.previous">পূর্ব বর্তী</message>
<message key="xmlui.Submission.general.submission.save">সংরক্ষণ করুন; প্রস্থান করুন</message>
<message key="xmlui.Submission.general.submission.next">পরবর্তী; </message>
<message key="xmlui.Submission.general.submission.complete">দাখিন করা সম্পূর্ণ হয়েছে</message>
<message key="xmlui.Submission.general.workflow.title">তালিকাভুক্ত বিষয়ের দাখিন</message>
<message key="xmlui.Submission.general.workflow.trail">তালিকাভুক্ত বিষয় দাখিন করুন</message>
<message key="xmlui.Submission.general.workflow.head">তালিকাভুক্ত বিষয় দাখিন করুন</message>
<message key="xmlui.Submission.general.showfull">সমস্ত বিষয়বস্তু দেখুন</message>
<message key="xmlui.Submission.general.showsimple">নির্দিষ্ট প্রাধান্য তালিকাভুক্ত বিষয় দেখানো হবে</message>
<message key="xmlui.Submission.general.default.title">দাখিন করুন</message>
<message key="xmlui.Submission.general.default.trail">দাখিন করুন</message>

<!-- org.dspace.app.xmlui.submission.CollectioViewer -->
<message key="xmlui.Submission.CollectionViewer.link1">এই সংগ্রহে একটি নতুন তালিকাভুক্ত বিষয় দাখিন করুন</message>

<!-- org.dspace.app.xmlui.submission.Navigation -->
<message key="xmlui.Submission.Navigation.submissions">দাখিন করুন</message>

```

Fig. 5.2.4.2: Modified Message File in Bengali (Submission Aspect)

Step 3

Making necessary changes in *server.xml* file (Configuration file of Tomcat) is required to ensure UTF-8 enabled transactions between Tomcat server and DSpace database. The first figure (5.2.4.3) shows default *server.xml* file and the second figure (5.2.4.4) shows the modified *server.xml* to support Unicode based database transactions.

```
<!-- Define a non-SSL HTTP/1.1 Connector on port 8080 -->  
  
<Connector  
port="8080" maxHttpHeaderSize="8192"  
    maxThreads="150" minSpareThreads="25" maxSpareThreads="75"  
    enableLookups="false" redirectPort="8443" acceptCount="100"  
    connectionTimeout="20000" disableUploadTimeout="true" />  
  
<!-- Note : To disable connection timeouts, set connectionTimeout value  
to 0 -->
```

Fig. 5.2.4.3: Programme box: Original entry in server.xml file

```
<Connector  
port="8080" maxHttpHeaderSize="8192"  
    maxThreads="150" minSpareThreads="25" maxSpareThreads="75"  
    enableLookups="false" redirectPort="8443" acceptCount="100"  
    connectionTimeout="20000" disableUploadTimeout="true"  
    URIEncoding="UTF-8"/>>
```

Fig. 5.2.4.4: Programme box: Modified entry in server.xml file

As discussed earlier (in section 4.2.1.8 of chapter 4), this research work recommends design and development of user interfaces both in Bengali and Hindi languages. Here steps are demonstrated only for making interface into Bengali language. In the same fashion, default English interface can be modified into Hindi language.

5.3 Design of Submission Interface

BURA holds varieties of textual and non-textual resources in different forms and formats (as suggested in section 4.2.1.3 of chapter 4). So it is essential for BURA to have standard metadata schema(s) for describing various items. BURA has decided to use Dublin Core (DC) and qualified DC as generic metadata schema for describing wide range of textual resources and suggests community/or domain-specific metadata elements for those objects where no suitable element or element refinement exists (as recommended in section 4.2.1.7 of chapter 4). In case of non-textual objects, BURA recommends respective domain-specific schemas for special objects like ETD (ETD-MS), Learning Objects (IEEE-LOM), Journal articles (Qualified DCMES) (as suggested in section 4.2.2 of chapter 4) respectively.

5.4 Development of Subject Access Control

This research work has incorporated DDC (22nd) in BURA software framework and modified it in Bengali. It has been restricted up to the third (3rd) Summary in view of the limited manpower and time. But it is a team work and can further be extended to incorporate the entire DDC structure by following the SKOS based method developed by this research work. The steps of making DDC (in English and Bengali) at the time of indexing as well as searching is discussed below with different screen snapshots (Fig. 5.4 through 5.4.3).

Step 1

Making necessary changes in *Dspace.cfg* file is the first logical step in integrating DDC (22nd edition – upto 3rd summary) in software framework. This step provides link (requires to display subject access system in submitter, editor and end user interfaces) between digital archive and available controlled vocabularies.

```
#### Controlled Vocabulary Settings ####
# Enable or disable the controlled vocabulary add-on
# Warning: this feature is not compatible with WAI (it requires javascript to function)
#
webui.controlledvocabulary.enable = true
```

Fig. 5.4: Script to Link to Control Vocabulary Device (DDC in DSpace)

Step 2

Next logical step is to link the target controlled vocabulary with submitter and editor interfaces through necessary modifications in *input.xml* file. The modified *input.xml* file of the system is displayed below:

```

<page number="2">
  <field>
    <dc-schema>dc</dc-schema>
    <dc-element>subject</dc-element>
    <dc-qualifier>ddc</dc-qualifier>
    <!-- An input-type of twobox MUST be marked as repeatable -->
    <repeatable>true</repeatable>
    <label>Subject Category</label>
    <input-type>twobox</input-type>
    <hint> Subject Category / Keywords from DDC (embedded)</hint>
    <required>You must enter atleast one category from DDC Third Summary in English</required>
    <vocabulary>ddcE</vocabulary>
  </field>

  <field>
    <dc-schema>dc</dc-schema>
    <dc-element>subject</dc-element>
    <dc-qualifier>other</dc-qualifier>
    <!-- An input-type of twobox MUST be marked as repeatable -->
    <repeatable>true</repeatable>
    <label>বিষয় পীষক</label>
    <input-type>twobox</input-type>
    <hint> বিষয়টির সূচনতন্ত্র অথবা রন্ধ্র নিখুঁত (ডিডে দগমিক বগীকরণ - তৃতীয়, প্রঃকিঃসার)</hint>
    <required>ডিডে দগমিক বগীকরণ - তৃতীয়, প্রঃকিঃসার হতেে ক্রটি বিষয়, পীষক নির্বাচন করুন</required>
    <vocabulary>ddcB</vocabulary>
  </field>

```

Fig. 5.4.1: Modified Input.xml File

Step 3

This research work attempts to integrate DDC 22nd edition (upto 3rd summary) in both English and Bengali scripts. English language subject divisions and subdivisions are based on DDC 22nd edition and Bengali language equivalents are based on the available translation work (Saha, 2008). The structure of the SKOS-enabled XML-formatted file displaying the hierarchy Social sc. >> Education >> Subject categories under ‘Education’ is given here in English.

```

<node id="370" label="Education">
  <isComposedBy>
    <node id="371" label="Generalities of education">
      <hasNote>Education</hasNote>
    </node>
    <node id="372" label="Elementary education">
      <hasNote>Education</hasNote>
    </node>
    <node id="373" label="Secondary education">
      <hasNote>Education</hasNote>
    </node>
    <node id="374" label="Adult education">
      <hasNote>Education</hasNote>
    </node>
    <node id="375" label="Curriculums">
      <hasNote>Education</hasNote>
    </node>
    <node id="376" label="unassigned">
      <hasNote>Education</hasNote>
    </node>
    <node id="377" label="unassigned">
      <hasNote>Educationhy</hasNote>
    </node>
    <node id="378" label="Higher education">
      <hasNote>Education</hasNote>
    </node>
    <node id="379" label="Public policy issues in education">
      <hasNote>Education</hasNote>
    </node>
  </isComposedBy>
</node>

```

Fig. 5.4.2: Original HTML File of DDC (3rd Summary)

Similarly, hierarchy Social sc. >> Education >> Subject categories under ‘Education’ is also displayed for Bengali script.

```

<node id="370" label="শিক্ষা">
  <isComposedBy>
    <node id="371" label="স্বল্পতম ৩ সালের শিশু, তরুণ: বিশেষ শিক্ষা">
      <hasNote>শিক্ষা</hasNote>
    </node>
    <node id="372" label="প্রারম্ভিক শিক্ষা">
      <hasNote>শিক্ষা</hasNote>
    </node>
    <node id="373" label="মাধ্যমিক শিক্ষা">
      <hasNote>শিক্ষা</hasNote>
    </node>
    <node id="374" label="বয়স্ক শিক্ষা">
      <hasNote>শিক্ষা</hasNote>
    </node>
    <node id="375" label="লাটিন">
      <hasNote>শিক্ষা</hasNote>
    </node>
    <node id="376" label="বিষয়, ক্ষেত্র, ট নেটে">
      <hasNote>শিক্ষা</hasNote>
    </node>
    <node id="377" label="বিষয়, ক্ষেত্র, ট নেটে">
      <hasNote>শিক্ষা</hasNote>
    </node>
    <node id="378" label="ডেপ্ট শিক্ষা">
      <hasNote>শিক্ষা</hasNote>
    </node>
    <node id="379" label="শিক্ষা ব্যবস্থায় প্রকারী নীতি">
      <hasNote>শিক্ষা</hasNote>
    </node>
  </isComposedBy>
</node>

```

Fig. 5.4.3: Modified HTML File in Bengali (DDC 3rd Summary)

The novelty of this SKOS-enabled vocabulary control system is that, submitter can add standard subject term(s) from DDC. It (DDC) has been incorporated in BURA software framework and will appear during submission and searching. At the time of submission of items to BURA, submitter has to select at least one term (one in English and another in Bengali) from each category, otherwise the system will show the caution message (Fig. 5.4.5) and submitter will not be allowed to go to the next step. The selection of subject term(s) from DDC for both categories (English and Bengali) is shown here in two different screen snapshots (Fig. 5.4.4 & Fig. 5.4.6).

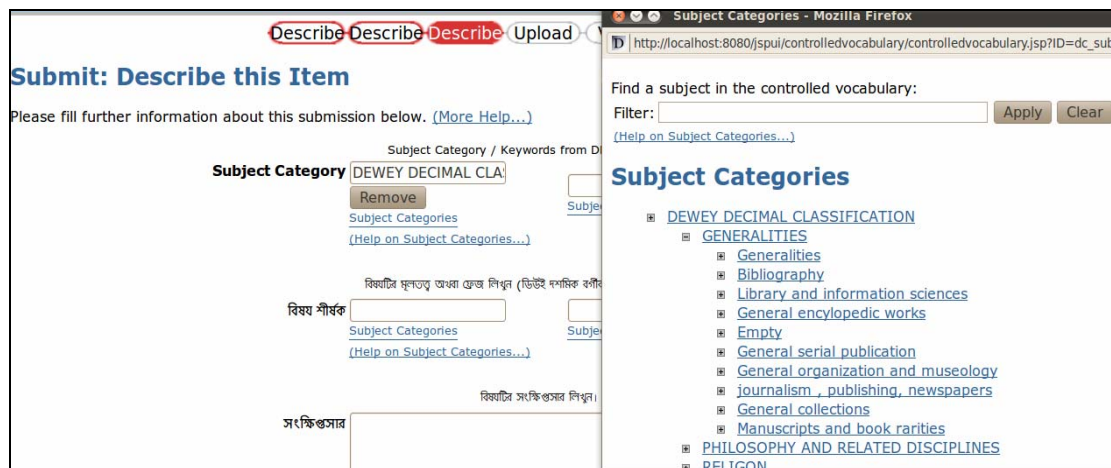


Fig. 5.4.4: Selection of Subject Categories from DDC (Category 1 – English)



Fig. 5.4.5: Display of Message for Selecting Subject Category

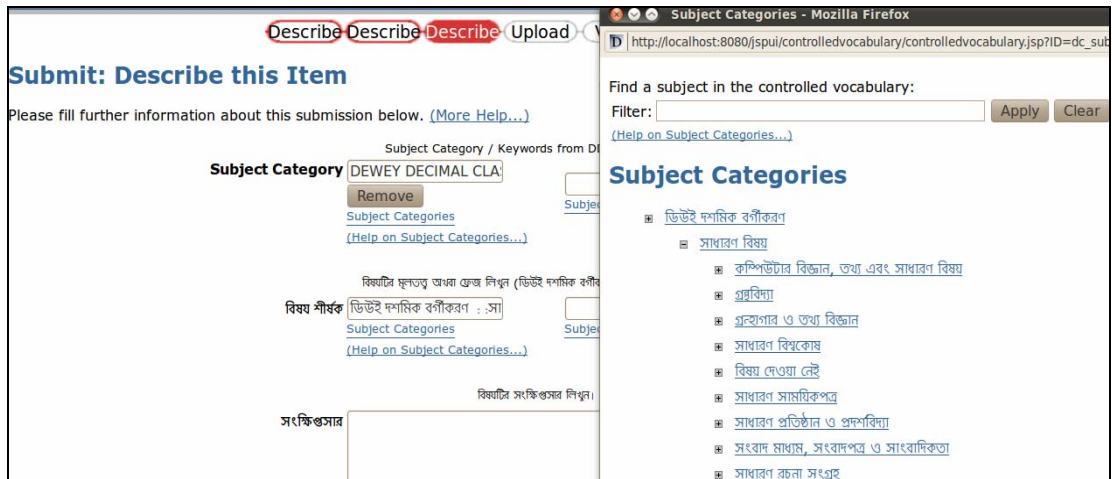


Fig. 5.4.6: Selection of Subject Categories from DDC (Category 2 - Bengali)

The next subsequent window (Fig. 5.4.7) displays the selected subjects in each category (English and Bengali) from DDC.

Fig. 5.4.7: Subject Categories Selected from DDC

After successful submission, reviewer/or metadata editor can further edit metadata of the submitted item(s) provided by the submitter at the time of submission and can add a new metadata for both categories (English & Bengali) from DDC (Fig. 5.4.8).

Fig. 5.4.8: Interface for Edition and Modification of Subject Categories

A click on ‘*Edit Metadata*’ option (Fig. 5.4.8) will lead to following facility:

লেখক	Roy, B. K	
আখ্যা	Open Access to scholarly information in India: Trends and Developments	
গ্রন্থমালা/প্রতিবেদন সংখ্যা	None	Correct one of these
সনাক্তিকরণ	None	
আকার	None	
ভাষা	None	
Subject Category	DEWEY DECIMAL CLASSIFICATION::GENERALITIES::Library and information sciences	
বিষয় শীর্ষক	ডিউই দশমিক বর্গীকরণ ::সাধারণ বিষয়:: গ্রন্থাগার ও তথ্য বিজ্ঞান::গ্রন্থাগার, মহাফেজখানা ও তথ্যকেন্দ্রের কর্মধারা, ডকুমেন্টেশন	Correct one of these
	ডিউই দশমিক বর্গীকরণ ::সাধারণ বিষয়:: কম্পিউটার বিজ্ঞান, তথ্য এবং সাধারণ বিষয়	
সংক্ষিপ্তসার	None	
আয়োজক	None	
বর্ণনা	None	

Fig. 5.4.9: Display of Results of Subject Categories (English & Bengali)

5.5 Development of Federated Search System

In section 4.2.1.7 of chapter 4, this research study proposed a metadata harvesting framework that will facilitate metadata extraction from OAI-PMH compliant repositories. The purpose of this federated search interface is to build an easy-to-use search service through automatic record harvesting for providing access to databases of worldwide open access repositories on different disciplines of interest.

The prototype harvesting framework for BURA is based on open source software (OSS) and open standards. This framework, like many other systems is based on LAMP (Linux – Apache – MySQL - PHP) architecture and all the necessary dependent tools must be activated and configured properly before installation of PKP (vide section 4.2.2.4.3 of chapter 4) harvester in Ubuntu. The figure (5.5) shows the harvester setting options in *dspace.cfg* file under the section with the following heading: *### Harvester settings*

```

### Harvester settings

# Crosswalk settings; the {name} value must correspond to a declared ingestion crosswalk
# harvester.oai.metadataformats.{name} = {namespace},{optional display name}
# The display name is only used in the xmlui for the.jspui there are entries in the
# Messages.properties in the form.jsp.tools.edit-collection.form.label21.select.{name}
harvester.oai.metadataformats.dc = http://www.openarchives.org/OAI/2.0/oai_dc/, Simple Dublin Core
harvester.oai.metadataformats.qdc = http://purl.org/dc/terms/, Qualified Dublin Core
harvester.oai.metadataformats.dim = http://www.dspace.org/xmlns/dspace/dim, DSpace Intermediate Metadata

# This field works in much the same way as harvester.oai.metadataformats.PluginName
# The {name} must correspond to a declared ingestion crosswalk, while the
# {namespace} must be supported by the target OAI-PMH provider when harvesting content.
# harvester.oai.oreSerializationFormat.{name} = {namespace}

# Determines whether the harvester scheduling process should be started
# automatically when the DSpace webapp is deployed.
# default: false
harvester.autoStart=false

# Amount of time subtracted from the from argument of the PMH request to account
# for the time taken to negotiate a connection. Measured in seconds. Default value is 120.
harvester.timePadding = 120

# How frequently the harvest scheduler checks the remote provider for updates,
# measured in minutes. The default value is 12 hours (or 720 minutes)
harvester.harvestFrequency = 720

```

Fig. 5.5: Script to Link to Metadata Harvesting Settings

As a whole, the use of OSS in developing prototype software framework depends on structured strategies, planning and methodology. The steps related to the process of designing harvesting prototype framework for the model BURA may be divided into four broad groups. These are as follows-

A. Installation related Functions

This harvesting framework requires different OSS that need to be installed are mentioned below -

- Operating system (OS): Ubuntu Version
- Database: MySQL Version
- Web server: Apache Version
- Programming language environment: PHP Version
- Harvester: PKP Harvester Version 2.0.1

B. Software (LAMP) related Activities

This group is mainly concerned with the development of the software framework. For this purpose, all those software are required to be customized and linked with each other properly. PKP harvester 2.X is based on AMP (Apache – MySQL – PHP) architecture. So the proposed framework requires installing (Apache, MySQL and PHP) those software before installation of PKP harvester. Although there is no hard and fast rule, the order of installation sequence is as follows:

- Apache (The Apache httpd server is powerful, flexible, HTTP/1.1 compliant open source Web server):
 - Installation of Apache;
 - Testing of Apache; and
 - Apache Configuration and Control.

- MySQL (MySQL, is the most powerful open source SQL database in open domain, is developed, distributed and supported by MySQL AB):
 - Installation of MySQL;
 - Initialization of MYSQL Server;
 - Creation of database, user and manage permission;
 - Testing of AMP Links through scripts;
 - Testing PHP - Apache Link; and
 - Testing PHP - MYSQL Link.

- PHP (PHP is an open source server side scripting language):
 - Installation of PHP; and
 - Configuration of PHP

C. Harvester related Functions

This part deals with selection, installation and configuration of harvesting tool. This group includes two major activities:

- Installation of PKP harvester (as proposed in section 4.2.2.4.3 of chapter 4)

The installation of PKP harvester is quite easy. It requires two sets of information –

- Login name and password (for administrator); and
- Database details (name of the MYSQL database, user of database and password of the database user).

- Configuration of PKP harvester

The configuration processes are divided into three main groups:

- Site management (configuration of site-specific details, language, crosswalk, plugins and reading tools);
- Archives (addition or creation of archives; editing or managing created archives); and
- Other administrative functions (layout, interface customization etc.).

D. Repository related Activities

The most important task of the repository administrator is to set up archive(s) for metadata harvesting. This part is concerned with the selection of repositories against predefined parameters (as proposed in section 4.2.2.4.2 of chapter 4) and collection of essential attributes for harvesting mentioned below –

- Name of the repository;
- Description of the repository;
- Base URL of the repository; and
- OAI-PMH URL (resource URL) of the repository.

This research study has selected repositories registered in OpenDoar database. The system (BURA) has the capability to include new OAI-PMH compatible OARs and to update records for existing OARs already in the system for the purpose of developing a comprehensive single window local search services for OARs.

5.5.1 Organization and Management of Repositories Harvested

This research study has selected sixty (60) OAI-PMH compliant repositories from OpenDOAR database against selected parameters (as suggested in section 4.2.2.4.2 of chapter 4). Any one can become a member of the system and can avail all the facilities provided by the system. User registration process includes ‘username’ and ‘password’ (Fig. 5.5.1) and the ‘Forgot your password?’ link (Fig. 5.5.2) allows users to set a new password.

The screenshot shows the user registration and login interface for the BURA system. At the top, there is a header for 'The University of Burdwan' with the tagline 'Learning Leads To Emancipation' and the main title 'Search Global Repositories @ BURA'. Below the header, there are navigation links: HOME, ABOUT, BROWSE, SEARCH, and HELP. A 'Log In' link is also present. The main content area features a 'Log In' section with a form containing 'Username' and 'Password' input fields, a 'Remember me' checkbox, and a 'Log In' button. Below the form, there are two links: 'Not a user? Register with this site' and 'Forgot your password?'.

Fig. 5.5.1: User Registration to Global Repositories System

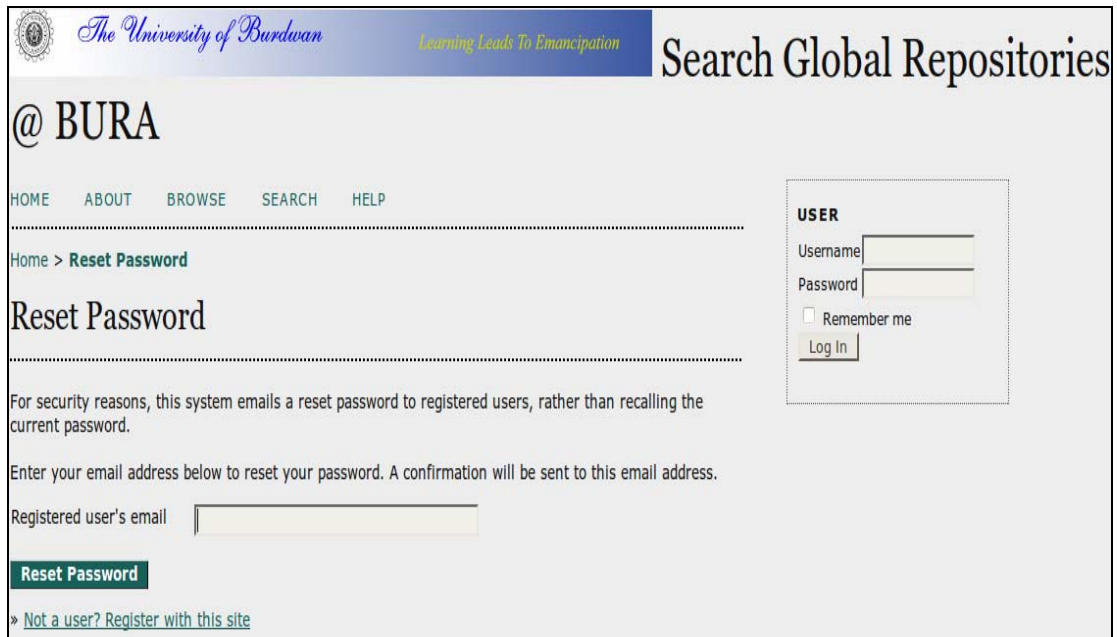


Fig. 5.5.2: Reset Password to Global Repositories System

The organization and management of repositories is vital task and system manager can do only after duly log in as administrator to BURA (Fig. 5.5.3).




Fig. 5.5.3: Log in as Administrator to Global Repositories System

The window (Fig. 5.5.4) allows administrator to perform various administrative operations (e.g. add, edit, manage etc.) in system level and is shown through different screen snapshots (Fig. 5.5.5 through Fig. 5.5.8).



Fig. 5.5.4: Organization and Management Interface of Global Repositories System

A click on 'Site Settings' option (Fig. 5.4.4) displays another window (Fig. 5.5.5) to configure the administrative interface of the harvesting framework.



The University of Burdwan
Learning Leads To Emancipation

Search Global Repositories @

BURA

HOME ABOUT USER HOME BROWSE SEARCH HELP

Home > Site Administration > **Site Settings**

Site Settings

General


Site title*

Introduction **This facility in BURA allows you to search an array of global selected repositories from a single-window interface.**

About the Site description **This facility in BURA allows you to search an array of global selected repositories from a single-window interface.**

Custom logo

File name: customLogo.jpg 2013-03-31 04:38 PM



Minimum password length* characters

Theme

Style sheet

Administration

Name of principal contact*

Email of principal contact*

Options

- Enable anyone to register and submit their archives for indexing.
- Submissions are disabled by default and must be enabled by the administrator.

* Denotes required field

Fig. 5.5.5: Site Management of Global Repositories System

Any time, addition, deletion, edition of repository(ies) is possible and button ‘*Add Archive*’ (Fig. 5.5.4) can be clicked to add a new repository to the system (Fig. 5.5.6).

Add Archive

Title*

Description

This is a subject based repository, containing materials relating to any aspect of library and information science. The site is especially rich in supporting material and documentation in a variety of EU languages (9 as of this audit) with content presented in most of these languages as well. Supported by a further 16 organisations in one way or another.

Archive Image

URL*
e.g. http://www.yourarchive.com

Enabled

Public ID
This unique identifier can be used in URL-based searches to identify this archive.

Type*

OAI Base URL*
e.g. http://www.yourarchive.com/oai/index.php

Admin Email

Options This is an OAI Static Repository

Index Method*

Metadata Format*
Click Refresh to update supported formats list for this archive.

Fig. 5.5.6: Addition of New Archive to the Global Repositories System

Managing archives is a vital task and can be done by clicking on ‘*Manage Archives*’ button (Fig. 5.5.4). A click on this button displays another window (Fig. 5.5.7) having three options and repository manager can pick up any buttons to perform the specific operation.

TITLE	URL	ARCHIVE MANAGER	TYPE	ACTION
Aquatic Commons	http://aquaticcommons.org/	lfladmin	OAI	EDIT MANAGE DELETE
Archive of European Integration (AEI)	http://aei.pitt.edu/	lfladmin	OAI	EDIT MANAGE DELETE
bepress Legal Repository	http://law.bepress.com/	lfladmin	OAI	EDIT MANAGE DELETE
Boston College Digital Collections	http://dcollections.bc.edu/R	lfladmin	OAI	EDIT MANAGE DELETE
Cadair 1.8.2	http://cadair.aber.ac.uk/dspace/	lfladmin	OAI	EDIT MANAGE DELETE
CaltechAUTHORS	http://authors.library.caltech.edu/	lfladmin	OAI	EDIT MANAGE DELETE
CCLRC ePublication Archive	http://epubs.stfc.ac.uk/	lfladmin	OAI	EDIT MANAGE DELETE
CERN Document Server	http://cds.cern.ch/	lfladmin	OAI	EDIT MANAGE DELETE
Cogprints (Cognitive Sciences ePrint Archive)	http://cogprints.org/	lfladmin	OAI	EDIT MANAGE DELETE
CONTENTdm Server Repository	http://contentdm.unl.edu/	lfladmin	OAI	EDIT MANAGE DELETE
D-Scholarship@Pitt	http://d-scholarship.pitt.edu/	lfladmin	OAI	EDIT MANAGE DELETE

Fig. 5.5.7: Archive Management Interface of Global Repositories System

The moment administrator clicks on ‘Edit’ option (Fig. 5.5.7), the system displays the selected archive (here E-LIS repository) and allows administrator making necessary changes (Fig. 5.5.8).

Edit Archive

EDIT ARCHIVE **MANAGE ARCHIVE**

Title*

Description
 This is a subject based repository, containing materials relating to any aspect of library and information science. The site is especially rich in supporting material and documentation in a variety of EU languages (9 as of this audit) with content presented in most of these languages as well. Supported by a further 16 organisations in one way or another.

Archive Image
 File name: main_banner_left.jpg 2013-03-16 12:44 PM

URL*
 e.g. http://www.yourarchive.com

Public ID Enabled
 This unique identifier can be used in URL-based searches to identify this archive.

Type*
 OAI Base URL*
 e.g. http://www.yourarchive.com/oai/index.php

Admin Email

Options This is an OAI Static Repository
 Index Method*
 Metadata Format*
 Click Refresh to update supported formats list for this archive.

* Denotes required field

Fig. 5.5.8: Modification and Edition of Archive Information

This software framework allows metadata to be harvested and extracted globally and can be done anytime by clicking on ‘Fetch archive metadata’ button (Fig. 5.5.6). Administrator can harvest all metadata or can restrict it by selecting different pre-defined categories (e.g. subject, type etc.) set by the repositories (Fig. 5.5.9). The system displays total number of metadata harvested and even allows updating metadata records by pressing ‘Update Metadata Index’ button (Fig. 5.5.9).

The University of Burdwan
Learning Leads To Emancipation

Search Global Repositories @
BURA

HOME ABOUT USER HOME BROWSE SEARCH HELP

Home > Site Administration > Archives > **Manage Archive**

Manage Archive

EDIT ARCHIVE **MANAGE ARCHIVE**

Title E-LIS repository
Record Count 14569
Last Indexed 2013-03-16

Sets
Subject = F. Management.
Subject = L. Information technology and library technology.: LM. Automatic text retrieval.
Type = Book chapter
Type = Presentation
Type = Journal article (On-line/Unpaginated)
Refresh

Record Dates
From: March 16 2013
Until:

Update Metadata Index Flush Metadata Cancel

Fig. 5.5.9: Fetch and Update Archive Metadata

Administrator can sort/or arrange repository(ies) in different orders (e.g. title, author, repository type) as specified by the repositories (Fig. 5.5.10).



Fig. 5.5.10: Sorting Order of Repositories

Any time, a new sorting order can be established by clicking on 'Create Sort Order' option (Fig. 5.5.10). The system manager can pick up any fields (Fig. 5.5.11) using drop down menu for creating a new order.



Fig. 5.5.11: Creation of New Sorting Order of Repositories

Even this existing sorting order can be modified and a fresh order can be re-established again by selecting different pre-defined fields as specified by the system (Fig. 5.5.12).

Fig. 5.5.12: Edition of Sorting Order of Repositories

5.6 Incorporation of User Interaction Tools

Community communication software (known as social software) allows digital interaction among community members through different user interaction tools such as RSS, Blog Discussion forum etc. BURA is fully compliant with these tools and can be incorporated in the software framework. These two social networking tools are developed with administrative interface of BURA and finally linked with BURA user interface.

A. RSS

RSS allows users to easily stay informed by retrieving the latest contents from the sites (BURA) without visiting it. The following are the steps to enable the use of RSS feeds in BURA. The following are the steps mentioned below:

Step 1: Administrator need to go the files (dspace-source/config/dspace.cfg) and has to perform the following steps:

- Edit the file [dspace-source] /config/dspace.cfg;
- Set webui.feed.enable = true; and
- Start Tomcat to get the result or for the changes to take effect.

All RSS feed options are available in *dspace.cfg* file under the section with the following heading: `<p class="Example">##### Syndication Feed Settings #####`

To enable RSS feeds for new/updated items in DSpace installation, Administrators need to set the following variable to -

```
true  
webui.feed.enable = false
```

```
##### Syndication Feed (RSS) Settings #####  
# enable syndication feeds - links display on community and collection home pages  
# (This setting is not used by XMLUI, as you enable feeds in your theme)  
webui.feed.enable = true  
# number of dspace items per feed (the most recent submissions)  
webui.feed.items = 4  
# maximum number of feeds in memory cache  
# value of 0 will disable caching  
webui.feed.cache.size = 100  
# number of hours to keep cached feeds before checking currency  
# value of 0 will force a check with each request  
webui.feed.cache.age = 48  
# which syndication formats to offer  
# use one or more (comma-separated) values from list:  
# rss 0.90, rss 0.91, rss 0.92, rss 0.93, rss 0.94, rss 1.0, rss 2.0  
webui.feed.formats = rss 1.0,rss 2.0,atom 1.0  
# URLs returned by the feed will point at the global handle server (e.g. http://hdl.handle.net/123456789/1)  
# Set to true to use local server URLs (i.e. http://myserver.myorg/handle/123456789/1)  
webui.feed.localresolve = false
```

Fig. 5.6: Script to Link to RSS Feed in User Interface

B. Blog

There are many open source software tools in the category of social networking software such as WordPress, Wblogs (Blog software). Selection of required Blog software for BURA software framework is absolutely based on the download statistics of Sourceforge (Sourceforge, 2012). It is the world's largest repository in the domain of open source software. As per this statistics the most popular Blog software, WordPress has maximum number of downloads and installations. It has been integrated with BURA software framework. The first figure (5.6.1) is meant for repository manager to configure the WordPress and the second figure (5.6.2) displays configuration window of WordPress (User interface of Blog service is shown in section 6.6 of chapter 6).

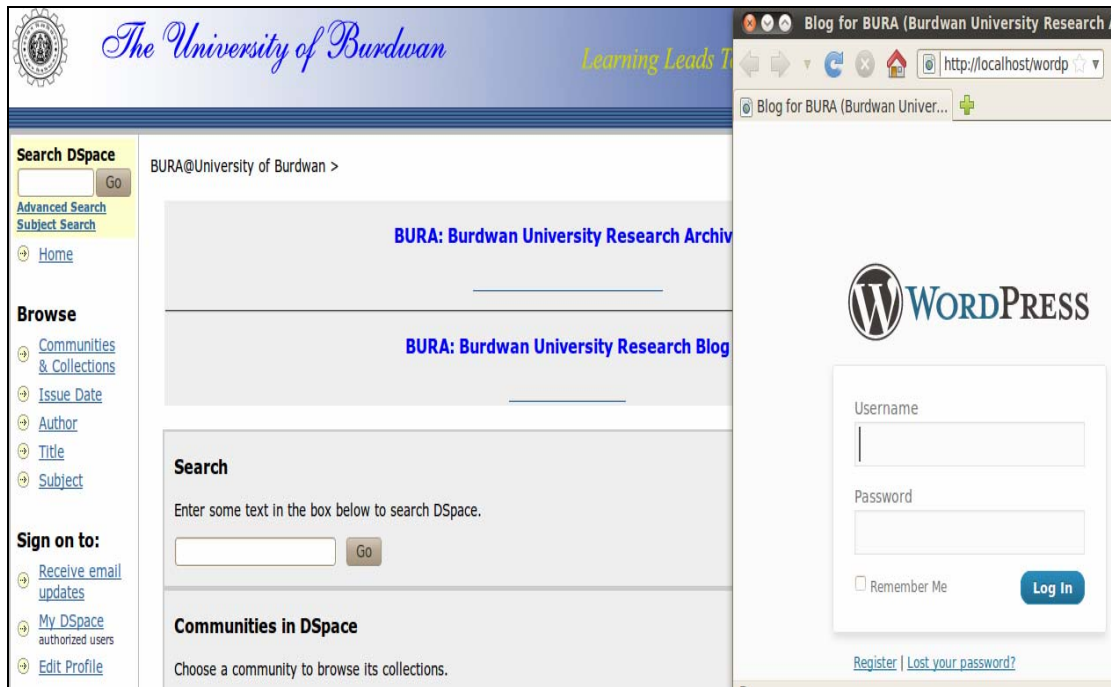


Fig. 5.6.1: Log in as Administrator to Blog of BURA

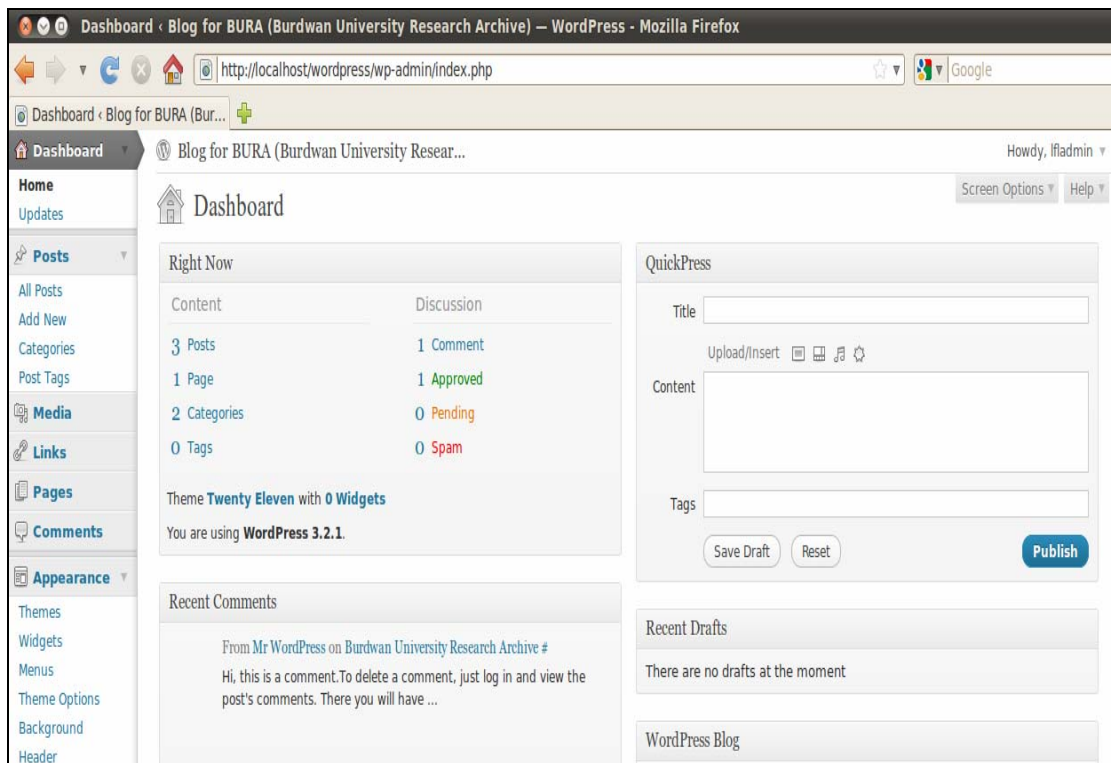


Fig. 5.6.2: Modified Interface of Blog of BURA

5.7 Backup and Restoration Process

The software framework of BURA is complex in nature as it includes seamless agglomeration of different domain-specific open standard software or software groups. Keeping in the requirements of the authority, this research work includes an accompanying CDROM containing all the ingredient software and BURA framework programmes. Regular backup of BURA resources in suitable media is necessary so that all processed data and records can be recovered to the point of system failure. BURA resources are stored in the IDR Cluster. The process of backup and restoration is demonstrated by using pgAdmin III (a third party open source tool for managing PostgreSQL DBMS) through three screen snapshots (Fig. 5.7 through Fig. 5.7.2).

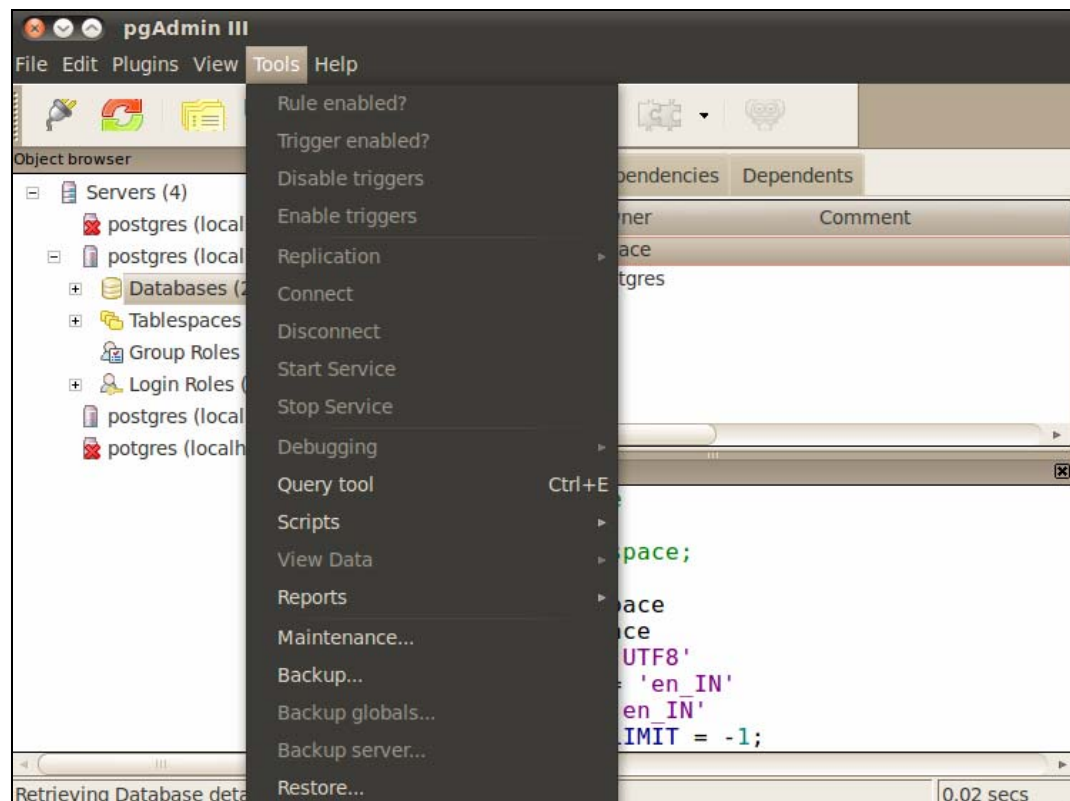


Fig. 5.7: Backup and Restoration (step 1)

The next logical step of this backup and restoration process is selecting the proper location where resources in the database of the system are to be stored (Fig. 5.7.1).

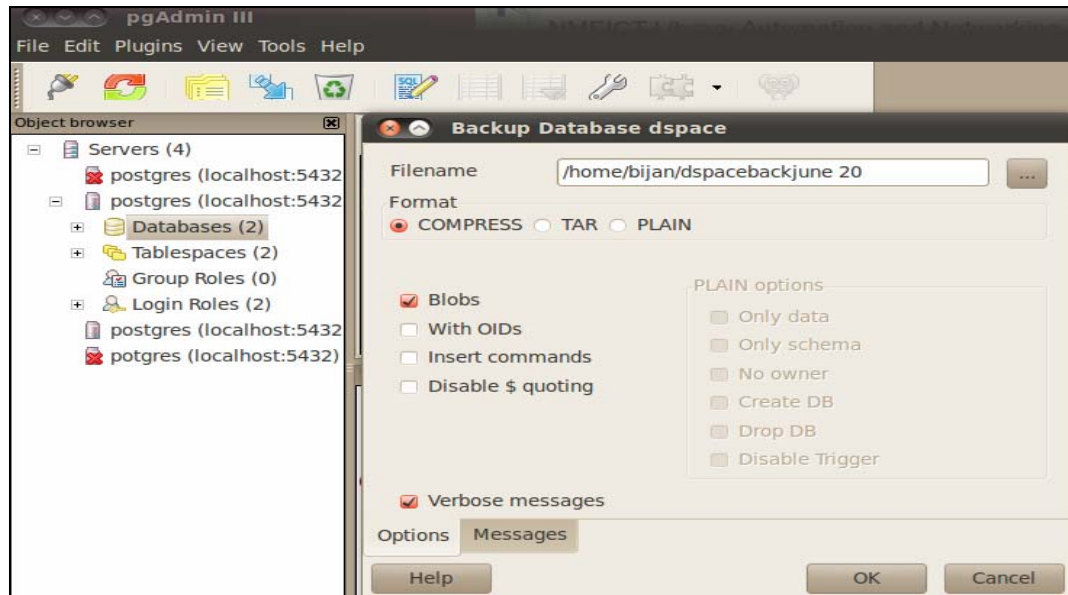


Fig. 5.7.1: Backup and Restoration (step 2)

Any time resources stored in the database can be restored by clicking on 'Restore' button (Fig. 5.7) and administrator can do it by selecting the file where resources were stored (Fig. 5.7.2).

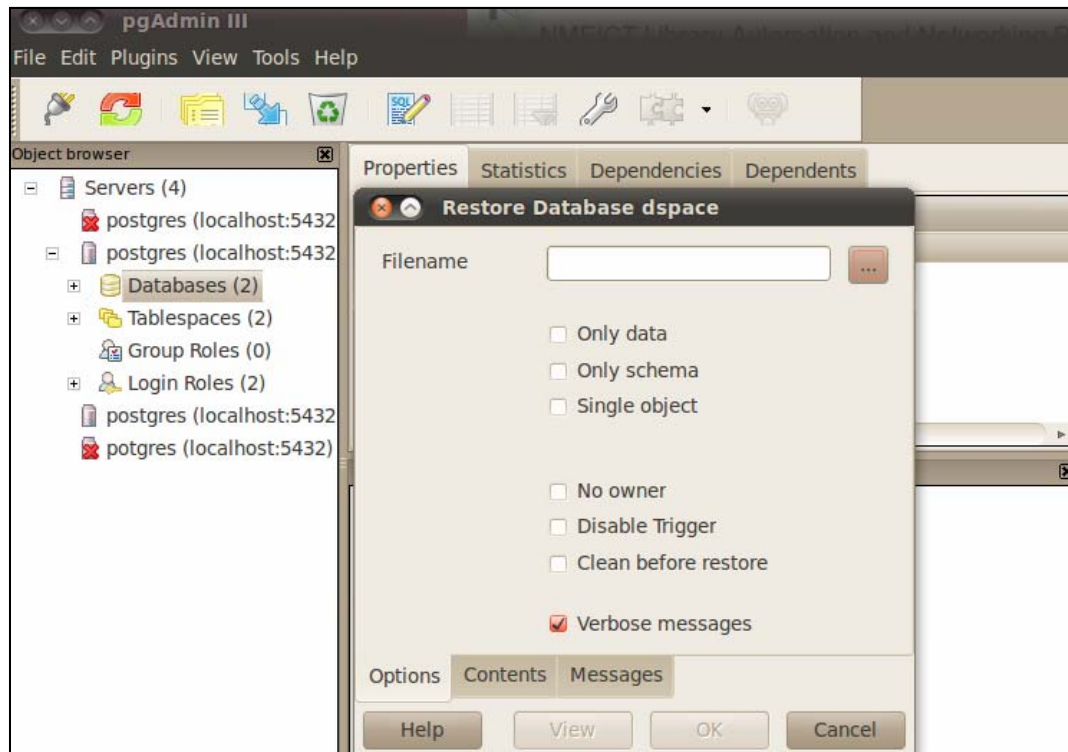


Fig. 5.7.2: Backup and Restoration (step 3)

5.8 Development of ISO image

This research promises to deliver a ready to use off-the-shelf products so that other universities can apply the results of this research in an easy way. The needs for developing such products are: - (i) ready to use Bengali script based interfaces developed for administrator, submitters, editors and end users; (ii) seamless export of SKOS-enabled DDC (22nd edition up to the 3rd summary) as controlled vocabulary to ensure standardization of subject authority file; (iii) allowing users of this software framework to implement integrated use of federated searching, community Blog, Discussion Forum and RSS based alerting services.

The basic purpose of this ready-to-use product is to help fellow professionals in implementing IDR in their respective institute based on the model BURA. This product, when installed, incorporates all the customizations and integration done by this research work without reconfiguring the system. This provides an opportunity to implement the software products as-it-is- basis without requiring technical skills and competencies. This research work also plans to release the product as open source utility through *source forge.net*.

The development of ISO file for BURA software framework is based on two sets of utilities -i) *Remastersys GUI* and ii) *Remastersys CUI*. The first set of utility generates raw ISO file and the second set of utility is responsible for fine tuning the ISO file in terms of file size control, name control, security control etc. The mechanisms for developing this product are as follows:

- A Checking of the BURA software framework to ensure all software features, utility software and add-ons are working in desired ways;**
 - B Generation of raw ISO image through remastersys; and**
 - C Fine tuning of ISO image through remastersys command.**
-
- B. Generation of raw ISO image through remastersys**

In this stage, first work is to invoke remastersys (Fig. 5.8).



Fig. 5.8: Log in to Remastersys

Remastersys allows generating of the ISO image of the software framework through the option “*Distribution*” (second in sequence). But before utilizing this facility, development process needs to set configuration. The appropriate configuration setting required for exporting BURA framework as ISO image is given in Fig. 5.8.1.

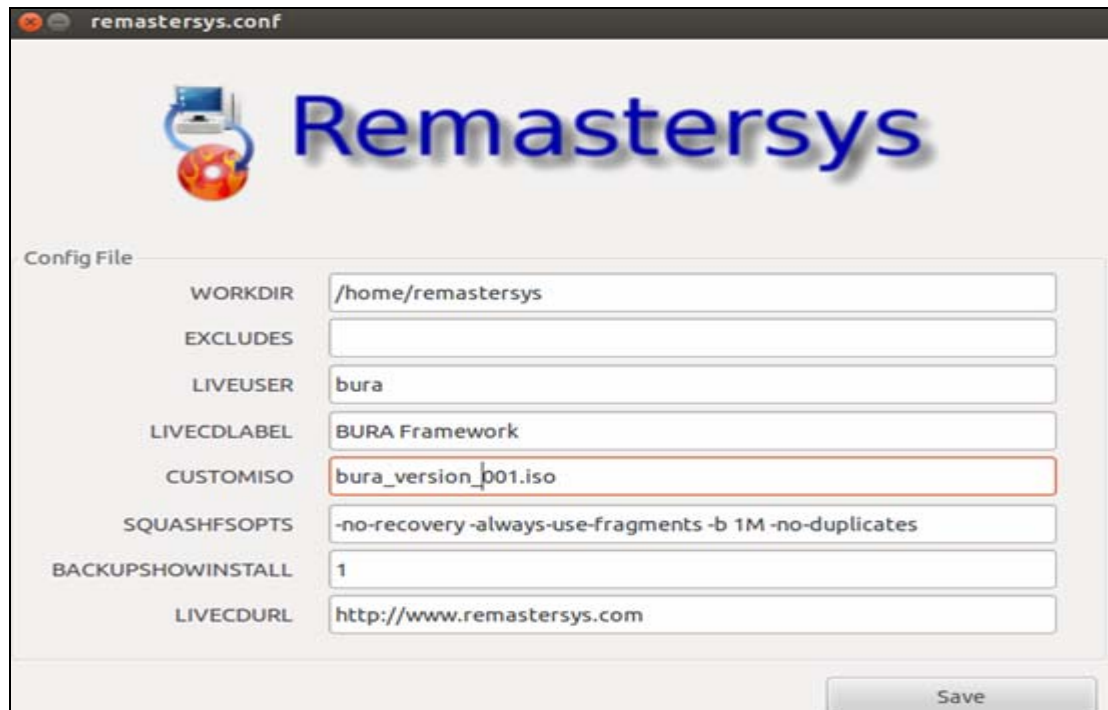


Fig. 5.8.1: Modification in Remastersys

C Fine tuning of ISO image through remastersys command

It is the final process of creating ISO image. After setting configuration in right manner, the process of developing ISO image may be started (Fig. 5.8.2 & Fig. 5.8.3).

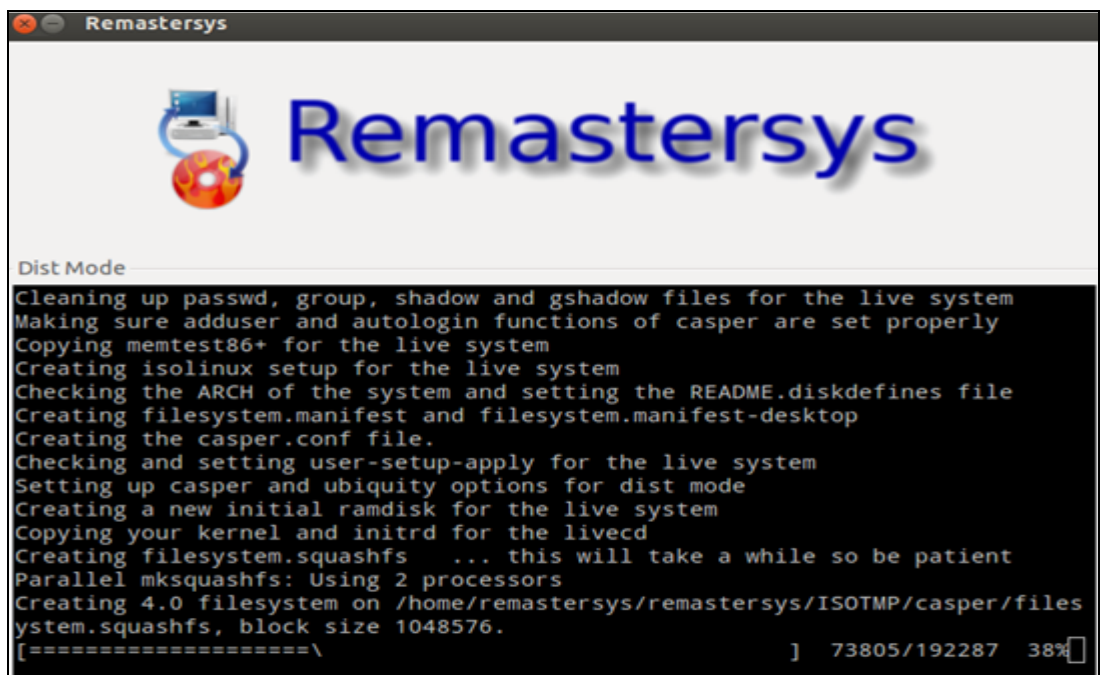


```

Remastersys

Distribution Mode Selected
Enabling remastersys-firstboot
System start/stop links for /etc/init.d/remastersys-firstboot already exist
.
Checking filesystem type of the Working Folder
/home/remastersys/remastersys is on a ext4 filesystem
Making sure popularity contest is not installed
Installing the Ubiquity GTK frontend
Checking if the /home/remastersys/remastersys folder has been created
Creating /home/remastersys/remastersys folder tree
Creating /home/remastersys/remastersys/ISOTMP folder tree
Copying /var and /etc to temp area and excluding extra files ... this will
take a while so be patient
    
```

Fig. 5.8.1: Process of developing ISO image (step 1)



```

Remastersys

Cleaning up passwd, group, shadow and gshadow files for the live system
Making sure adduser and autologin functions of casper are set properly
Copying memtest86+ for the live system
Creating isolinux setup for the live system
Checking the ARCH of the system and setting the README.diskdefines file
Creating filesystem.manifest and filesystem.manifest-desktop
Creating the casper.conf file.
Checking and setting user-setup-apply for the live system
Setting up casper and ubiquity options for dist mode
Creating a new initial ramdisk for the live system
Copying your kernel and initrd for the livecd
Creating filesystem.squashfs ... this will take a while so be patient
Parallel mksquashfs: Using 2 processors
Creating 4.0 filesystem on /home/remastersys/remastersys/ISOTMP/casper/files
ystem.squashfs, block size 1048576.
[=====\\ ] 73805/192287 38%
    
```

Fig. 5.8.1: Process of developing ISO image (step 2)

Chapter 6

Development of Services



It's a truism in technological development that no silver lining comes without its cloud.

Bruce Sterling (Opening Statement
to the House Subcommittee on Telecommunications and Finance, Washington D. C.)

Structure

- 6.0 Introduction
- 6.1 Administration of BURA
- 6.2 Services of BURA
- 6.3 Multilingual Features
- 6.4 Federated Search
- 6.5 Subject Authority Management
- 6.6 Utility Services
- 6.7 Miscellaneous Administrative Services

6.0 Introduction

This chapter deals with designing and development of a service model of the software framework BURA (Burdwan University Research Archive) and also describes different core components of the service model. This chapter describes various steps involved in administering DSpace, like creating and maintaining Communities, Sub-communities and Collections, user registration, creation of E-People; authorizing E-People to submit to the Collections; creating and maintaining E-Groups, designing workflow, withdraw and removal of items etc. The chapter describes browsing and searching of different Communities and Collections with different search syntax. This chapter also shows process of metadata harvesting from different OAI-PMH compatible repositories via protocols like OAI/PMH and user can search many IDs at a time from a single-window search interface. Another feature of this chapter is to provide an alternative way for users to access different interactive communication tools like Blog (in order to keep them up to date with the latest information posted on BURA blog site) and getting news for updated contents in BURA through RSS feed. The chapter also describes development of multi-lingual features and allow users searching, browsing and retrieving of different regional languages like Bengali/or Hindi languages. This chapter also shows the process of browsing and searching of specific subject category using Indic-script based subject access system to enhance subject categories.

6.1 Administration of BURA

This section describes various steps involved in administering DSpace, such as creating, modifying and removing and maintaining Communities, Sub-communities and Collections, user registration, creation of E-People; authorizing E-People to submit to the Collections; creating and maintaining E-Groups, designing workflow and selection of E-person(s) or Groups for workflow, withdraw and removal of items etc. The tasks begin with creating Communities and Collections and some steps in BURA are essential and some are optional. These steps have been enumerated here.

A. Essential Steps:

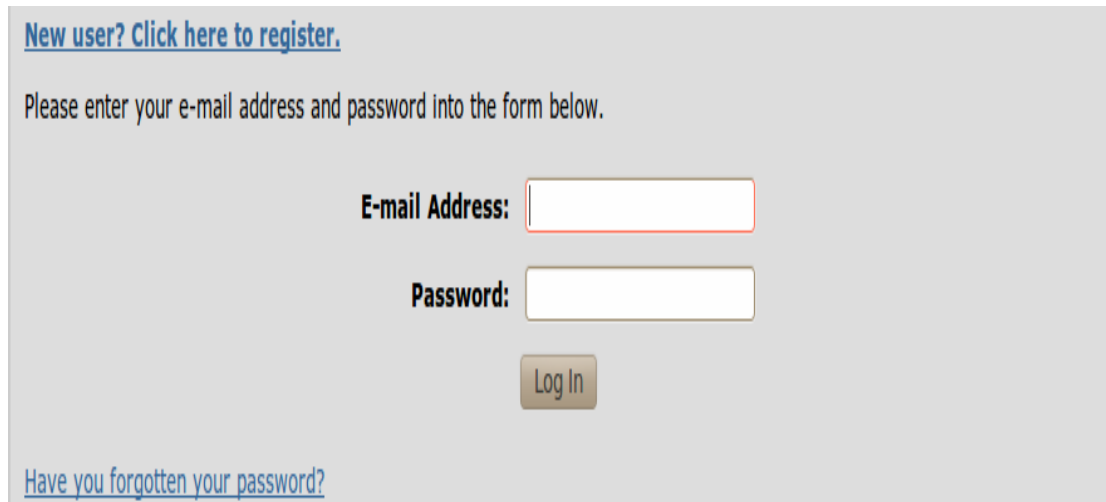
- Create Community and Sub-community
- Create Collection
- Create Collection authorizations
- Create Users who will act as reviewers, metadata editors, approvers

Administrator can also perform the following optional steps for fine tuning of the BURA –

B. Optional Steps:

- Creating Sub-communities
- Creation of Groups
- Modifying Dublin Core Registry (Discouraged)
- Adding additional file formats to Bitstream Format Registry
- Modifying or Deleting Digital Items
- Handling News

Administrator can log into BURA by entering following URL in the browser *http://<domain/IP>:8080/dspace/dspace-admin*. In this research study, it can be done here by *http://localhost:8080/dspace/dspace-admin* and administrative operations can be performed using the following interface (Fig. 6.1).



[New user? Click here to register.](#)

Please enter your e-mail address and password into the form below.

E-mail Address:

Password:

[Have you forgotten your password?](#)

Fig. 6.1: Log in as Administrator

6.1.1. Creation of Top Level Community

In DSpace, repository is organized in terms of Community(s) and Collection(s) and optionally one can create Sub-community (s) under each Community and also any number of levels of Sub-communities under each Sub-community. It can be anything and there is no hard and fast rule in designing Community(s) and Sub-community(s). One can use ‘Dewey Decimal Classification’ (DDC) system and any other classification system depending on policy of the repository can be used to organize repository resources. The Community(s) and Collection(s) need not be subject-wise. In other words, Community(s) and Sub-community(s) can be arranged hierarchically.

The following are the steps that a repository administrator should follow in creating Community and Sub-community in BURA:

- A name to the community (mandatory);
- A short description of the community (optional);
- An introductory text (in html format) about the community (optional);
- A copyright note (optional);
- Text (in html) to be appeared on the right column of the Digital repository page (optional);
- A logo to appear on the community page (optional); and
- A list of e-people, who can modify the logo (optional).

Three top level Communities (Fig. 6.1.1) have been created for the BURA software framework under which different academic departments (here Sub-communities) have been created (vide section 4.2.1.2 of chapter 4).

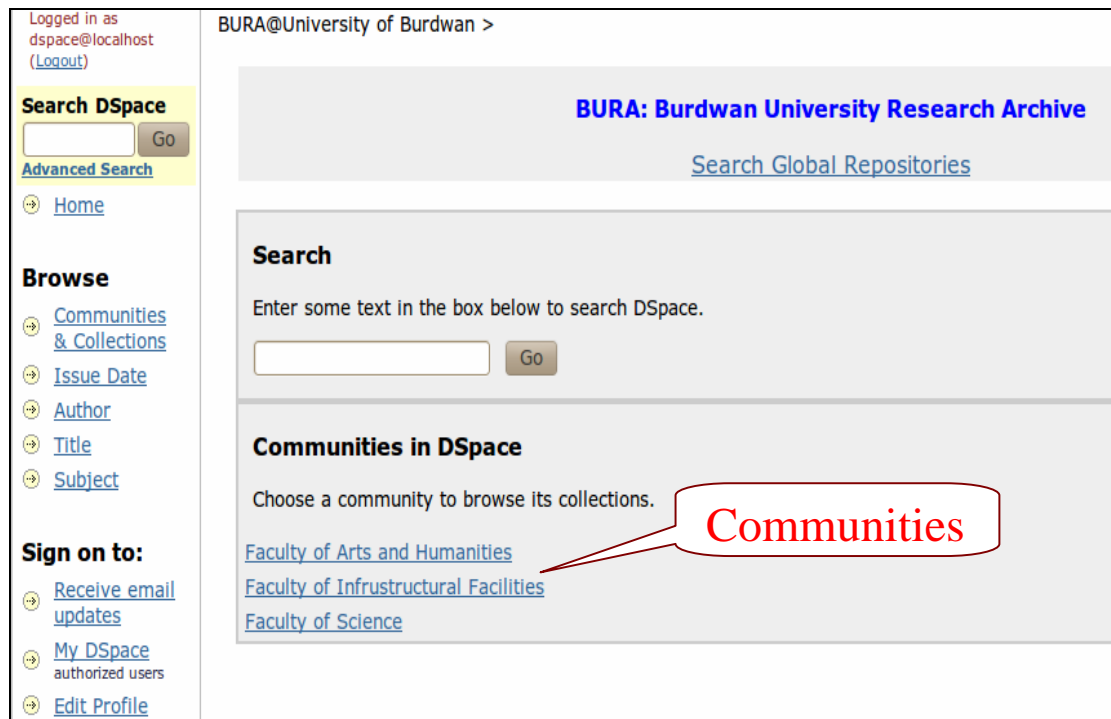


Fig. 6.1.1: Top Level Communities of BURA

The moment repository administrator clicks on ‘*Communities/Collections*’ button (Fig. 6.1.1.1) at the top left corner of the window, this option displays a window (Fig. 6.1.1.2) from where new Community can be created. Another window (Fig. 6.1.1.3) is displayed and finally ‘*Create*’ button can be clicked to have the Community.

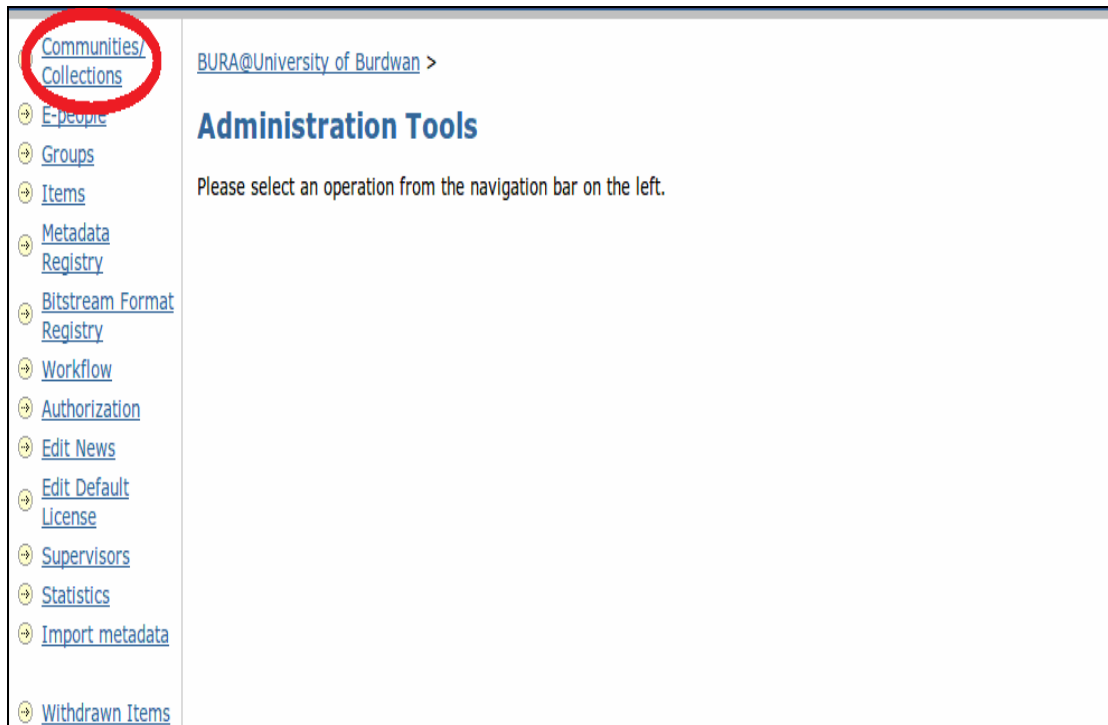


Fig. 6.1.1.1: Community creation (step 1)

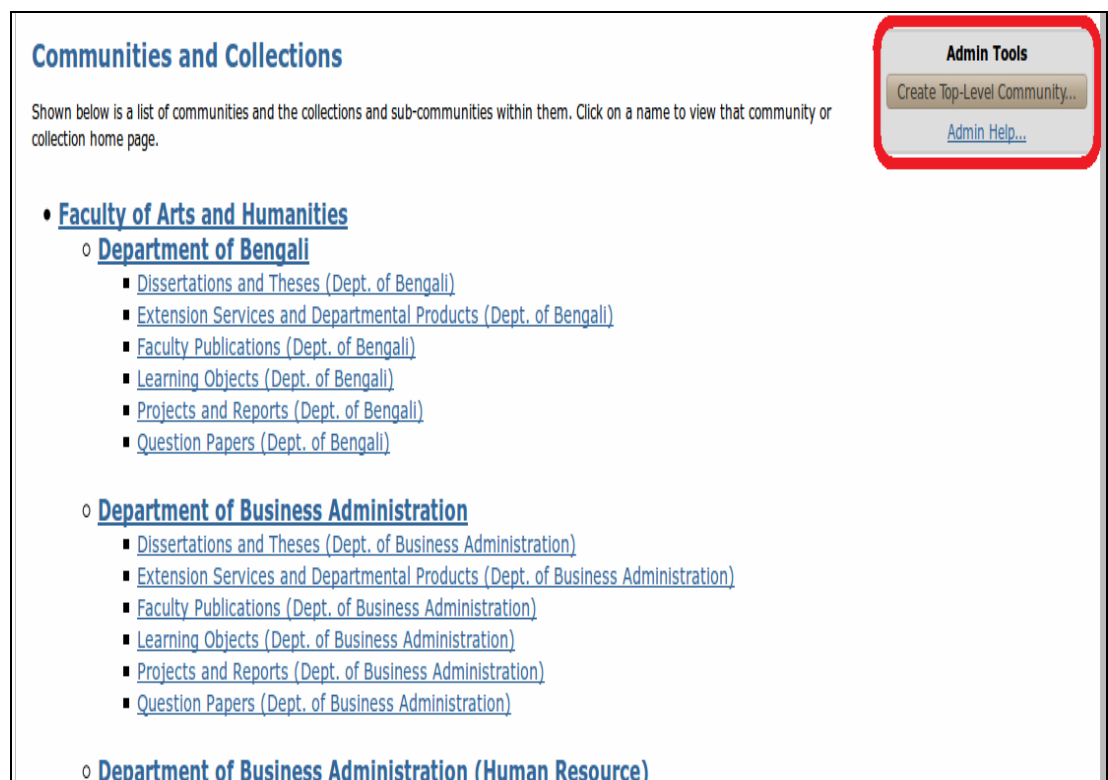


Fig. 6.1.1.2: Community creation (step 2)

Fig. 6.1.1.3: Community creation (step 3)

6.1.2. Deletion of Top Level Community

In the same way like creating Community in section 6.1.1, it can be deleted by clicking on 'Edit' button from Admin Tools box (Fig. 6.1.2).

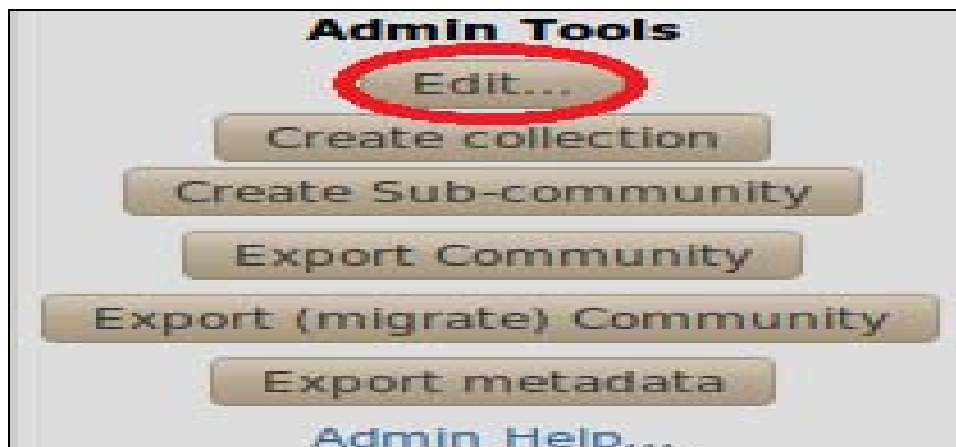


Fig. 6.1.2: Community deletion (step 1)

The moment administrator clicks on 'Delete this Community' button (Fig. 6.1.2.1) displays another window (Fig. 6.1.2.2) and finally clicking of 'Delete' button automatically delete it.

Edit Community 123456789/1

Delete this Community...

Name: Faculty of Arts and Humanities

Short Description BURA (Burdwan University Research Archive)

Introductory text (HTML):

Copyright text (plain text):

Side bar text (HTML):

Logo: Upload a logo...

Community Administrators: Create

Community's Authorizations: Edit...

Update Cancel

Fig. 6.1.2.1: Community deletion (step 2)

[BURA@University of Burdwan](#) >
[Administer](#) >

Delete Community: 1

Are you sure the community **Faculty of Arts and Humanities** should be deleted? This will delete:

- Any collections in the community that are not contained in other communities
- Any items and incomplete submissions in those collections that aren't contained in other collections
- The contents of those items
- All associated authorisation policies

Delete Cancel

Fig. 6.1.2.2: Community deletion (step 3)

6.1.3. Creation of Sub-community

BURA administrator can create Sub-community (i.e. academic departments) under any Community (vide section 4.2.1.2 of chapter 4). After selecting appropriate Community (i.e. Faculty of Arts and Humanities), the moment administrator clicks on the 'Create Sub-community' button (Fig. 6.1.3), the window (Fig. 6.1.3.1) allows

creating it (here Department of Library and Information Science) by clicking of ‘create’ button.

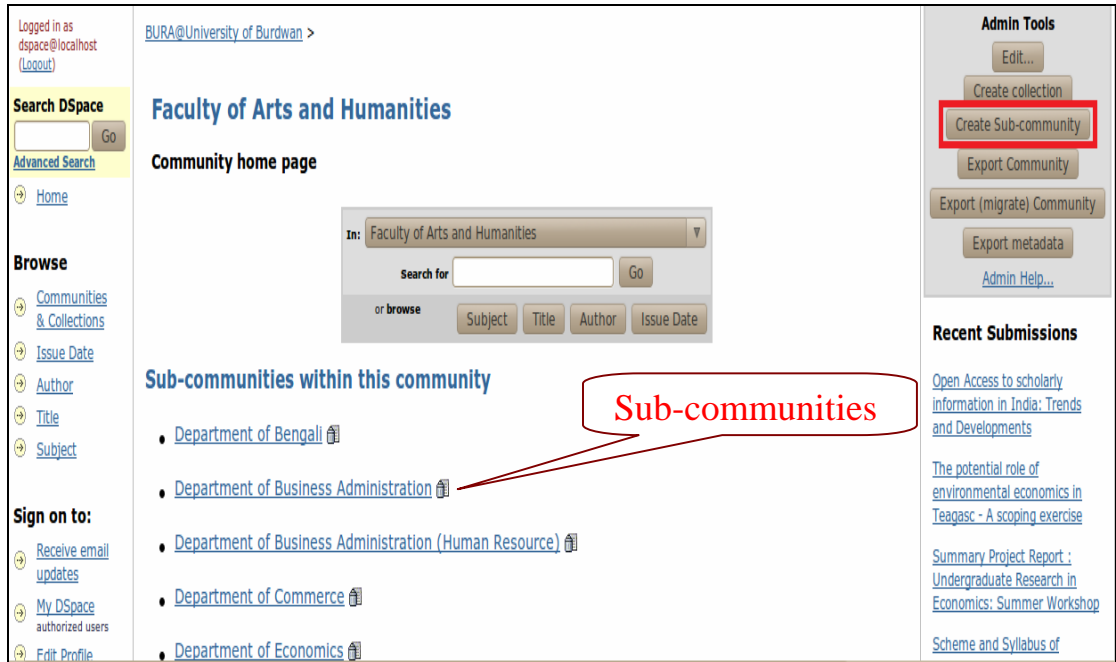


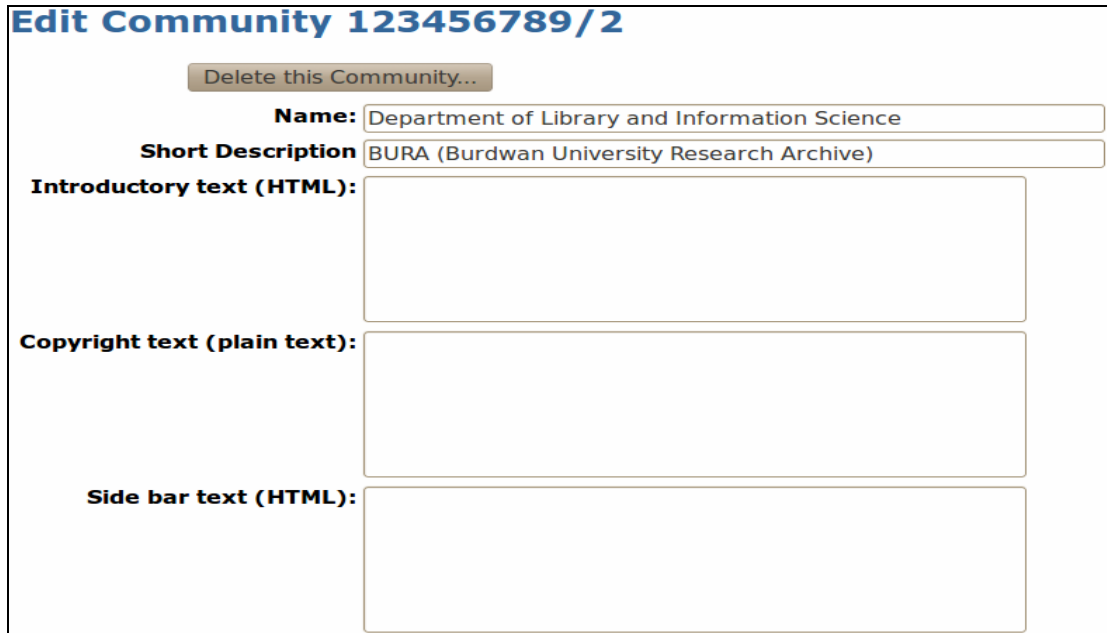
Fig. 6.1.3: Creation of Sub-community (step 1)



Fig. 6.1.3.1: Creation of Sub-community (step 2)

6.1.4. Deletion of Sub-community

Sub-community can also be deleted if authority so desires and it can be done by clicking on “*Edit*” button (Fig. 6.1.2) from Admin Tools box. Interface (Fig. 6.1.4) given below allows administrator to delete it. It can be used to edit the Sub-community name. Finally clicking of ‘*Delete*’ button (Fig. 6.1.4.1) automatically delete it.



Edit Community 123456789/2

Delete this Community...

Name: Department of Library and Information Science

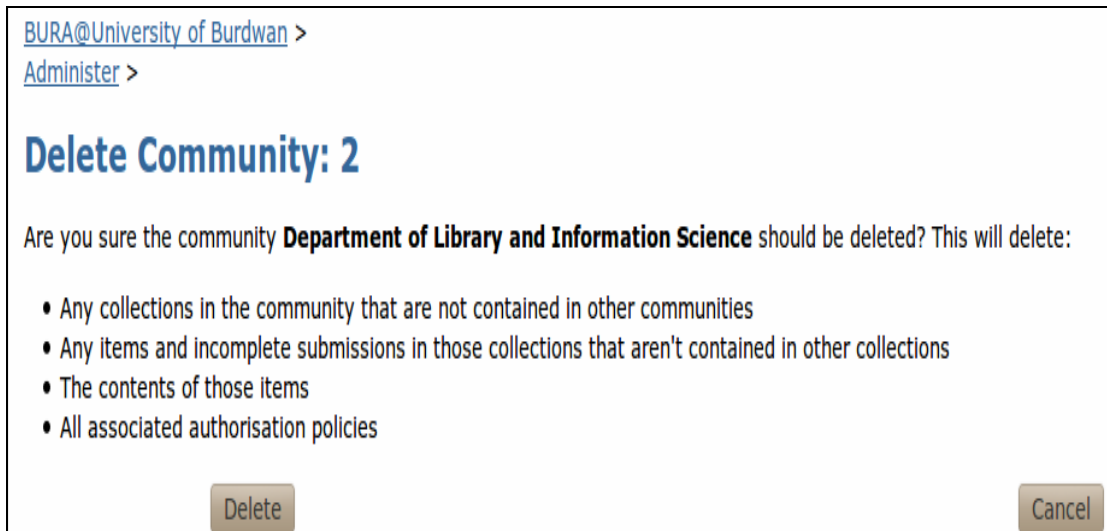
Short Description BURA (Burdwan University Research Archive)

Introductory text (HTML):

Copyright text (plain text):

Side bar text (HTML):

Fig. 6.1.4: Delete Sub-community



[BURA@University of Burdwan](#) >
[Administer](#) >

Delete Community: 2

Are you sure the community **Department of Library and Information Science** should be deleted? This will delete:

- Any collections in the community that are not contained in other communities
- Any items and incomplete submissions in those collections that aren't contained in other collections
- The contents of those items
- All associated authorisation policies

Delete Cancel

Fig. 6.1.4.1: Sub-community Deleted

6.1.5. Creation of Collections

Creating Collections for any repository system is essential and it can be created only after having a Community or Sub-community (if any) in the system. Community maintains an unlimited number of Collections in the system. It (Community) can have a combination of Sub-communities and Collections. Again under each Sub-community there can be sub-sub-communities and Collections. However, Collection can not be sub-divided into sub-collections. It is the Collections that hold digital items (also referred as digital documents or digital objects). BURA has the following six (6) types of Collections under each academic department (as suggested in section 4.2.1.3 of chapter 4).

- *Dissertations and Theses (Collection Type - 1)*
- *Extension Services and Departmental Products (Collection Type - 2)*
- *Faculty Publications (Collection Type - 3)*
- *Learning Objects (Collection Type - 4)*
- *Projects and Reports (Collection Type - 5)*
- *Question Papers (Collection Type - 6)*

The following figure (6.1.5) shows Collections type under the Sub-community 'Department of Library and Information Science' which has been created under the top level Community 'Faculty of Arts and Humanities'.

BURA@University of Burdwan >
Faculty of Arts and Humanities >

Department of Library and Information Science

Community home page

In: Department of Library and Information Science

Search for Go

or browse

Collections in this community

- [Dissertations and Theses \(Dept. of Lib. & Inf. Sc.\)](#)
- [Extension Services and Departmental Products \(Dept. of Lib. & Inf. Sc.\)](#)
- [Faculty Publications \(Dept. of Lib. & Inf. Sc.\)](#)
- [Learning Objects \(Dept. of Lib. & inf. Sc.\)](#)
- [Projects and Reports \(Dept. of Lib. & Inf. Sc.\)](#)
- [Question Papers \(Dept. of Lib. & Inf. Sc.\)](#)

Collections Types

Fig. 6.1.5: Collections Types of BURA

The process of creating Collection is shown here through fifteen screen snapshots (Fig. 6.1.5.1 through Fig. 6.1.5.15). Here 'Faculty Publications' has been created as a Collection under the Sub-community 'Library and Information Science'. It (Collection) can be created by clicking on second option 'Create Collection' from Admin Tools box at the top right hand corner of the window (Fig. 6.1.5.1).



Fig. 6.1.5.1: Community selection for creating Collection

The next logical step is selection of workflow (vide section 4.2.1.12 of chapter 4) for the Collection and interface (Fig. 6.1.5.2) given below allows to design workflow as proposed in the repository policy.

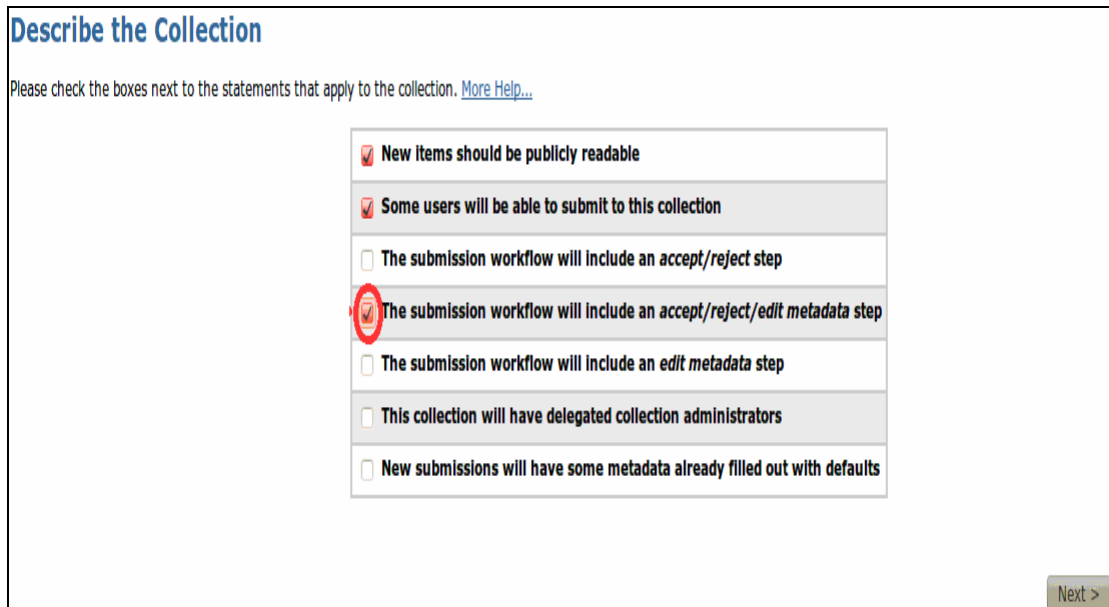


Fig. 6.1.5.2: Workflow selection

The moment administrator clicks on the button ‘Next’ (Fig. 6.1.5.2), the system displays the window (Fig. 6.1.5.3) for entering required data in appropriate boxes.

Describe the Collection
[Help...](#)

Name:

Shown in list on community home page

Short Description:

HTML, shown in center of collection home page. Be sure to enclose in <P> </P> tags!

Introductory text:

Plain text, shown at bottom of collection home page

Copyright text:

HTML, shown on right-hand side of collection home page. Be sure to enclose in <P> </P> tags!

Side bar text:

License that submitters must grant. Leave this blank to use the default license.

License:

Plain text, any provenance information about this collection. Not shown on collection pages.

Provenance:

Choose a JPEG or GIF logo for the collection home page. Should be quite small.

Logo:

Fig. 6.1.5.3: Description of Collection

The next logical step is selection of submitter(s) for the Collection and this vital task has been demonstrated here through three screen snapshots (Fig. 6.1.5.4 through Fig. 6.1.5.6). The window (Fig. 6.1.5.4) displays all the E-person(s) in the system and Collection administrator can add/or remove submitter(s) from the list and is shown through two screen snapshots (Fig. 6.1.5.5 & Fig. 6.1.5.6).

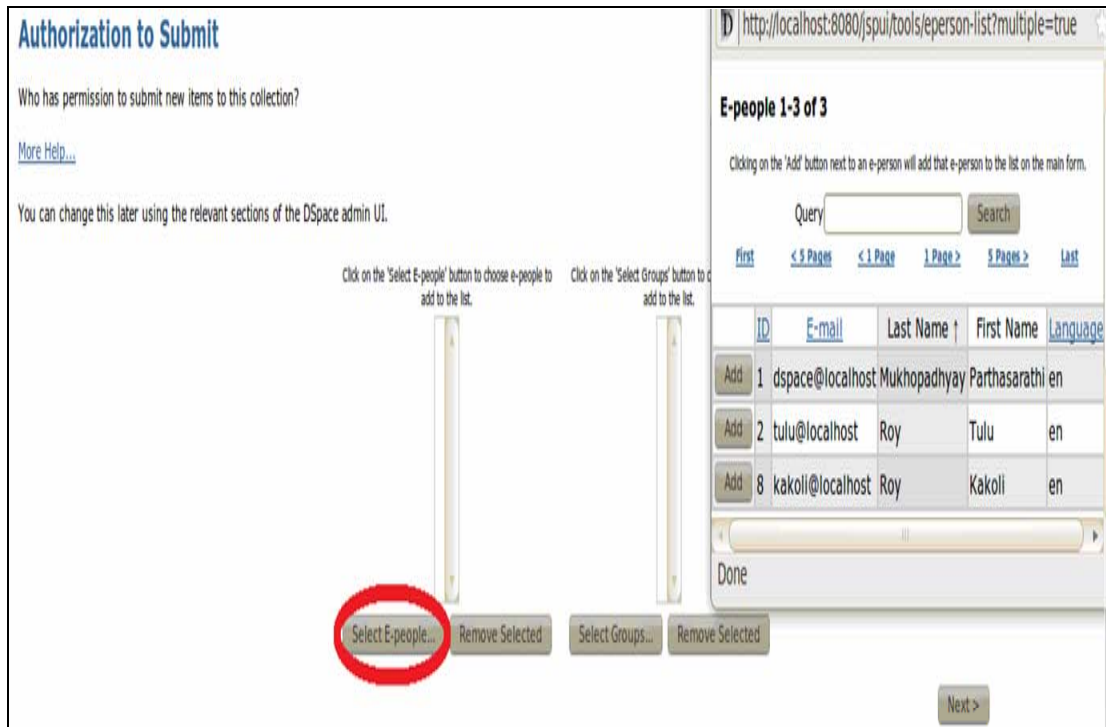


Fig. 6.1.5.4: Selection of E-person for Submission

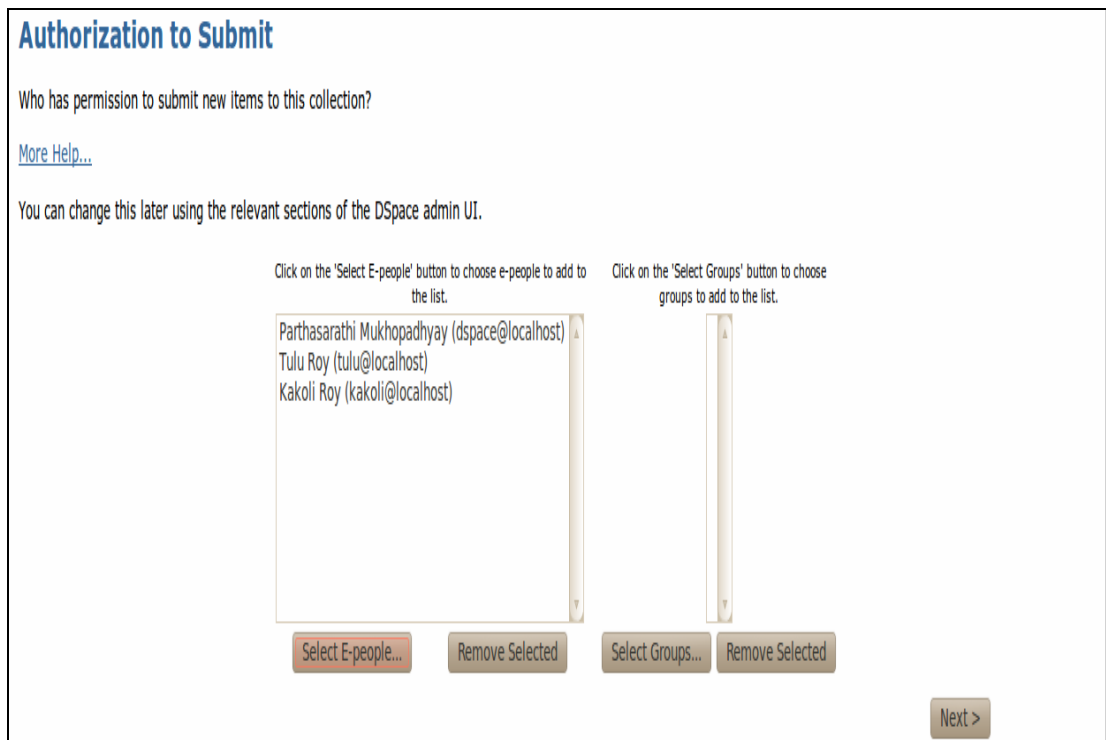


Fig. 6.1.5.5: List of selected Submitters

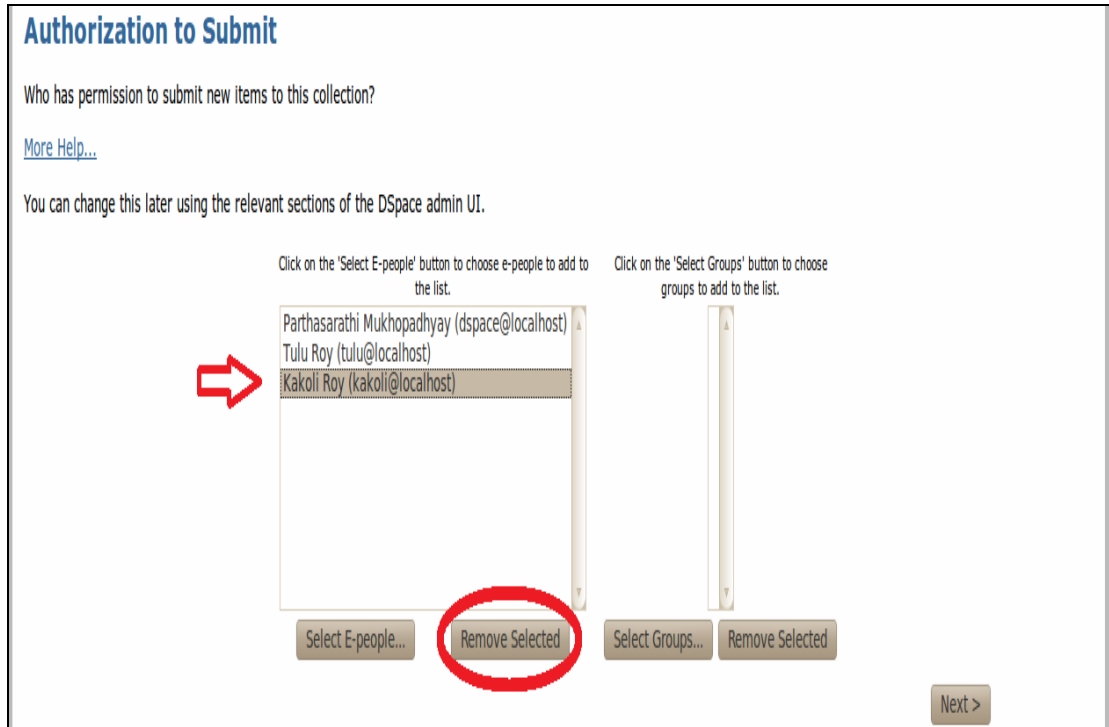


Fig. 6.1.5.6: Removal of Submitter

This submitter(s) list can also be edited and modified by clicking on ‘*Edit Submitters*’ button (Fig. 6.1.5.7) and is shown here through two screen snapshots (Fig. 6.1.5.8 & Fig. 6.1.5.9).

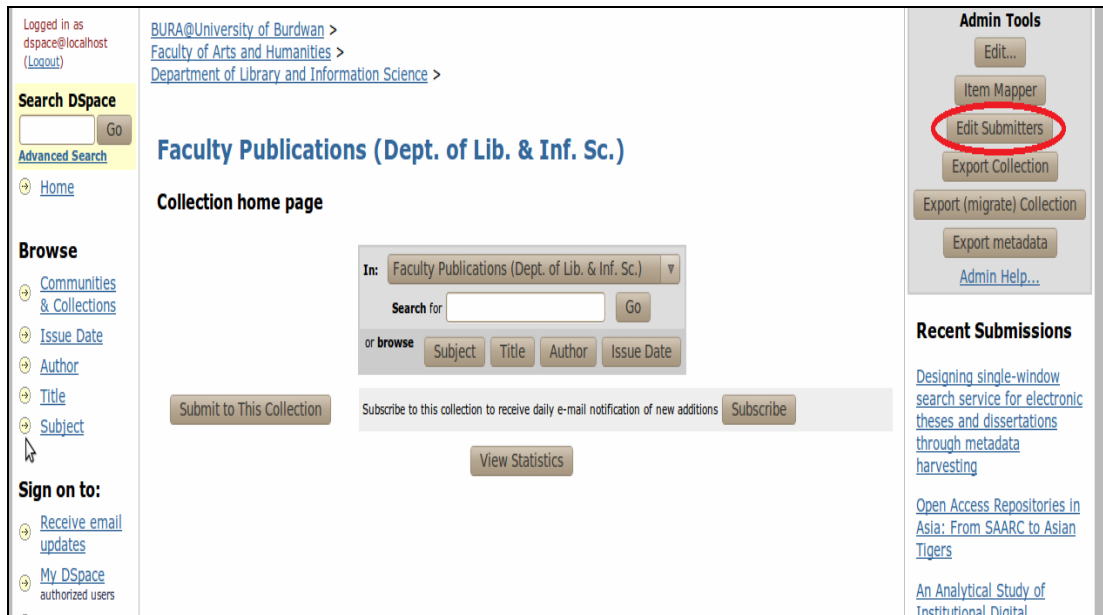


Fig. 6.1.5.7: Edit Submitters List

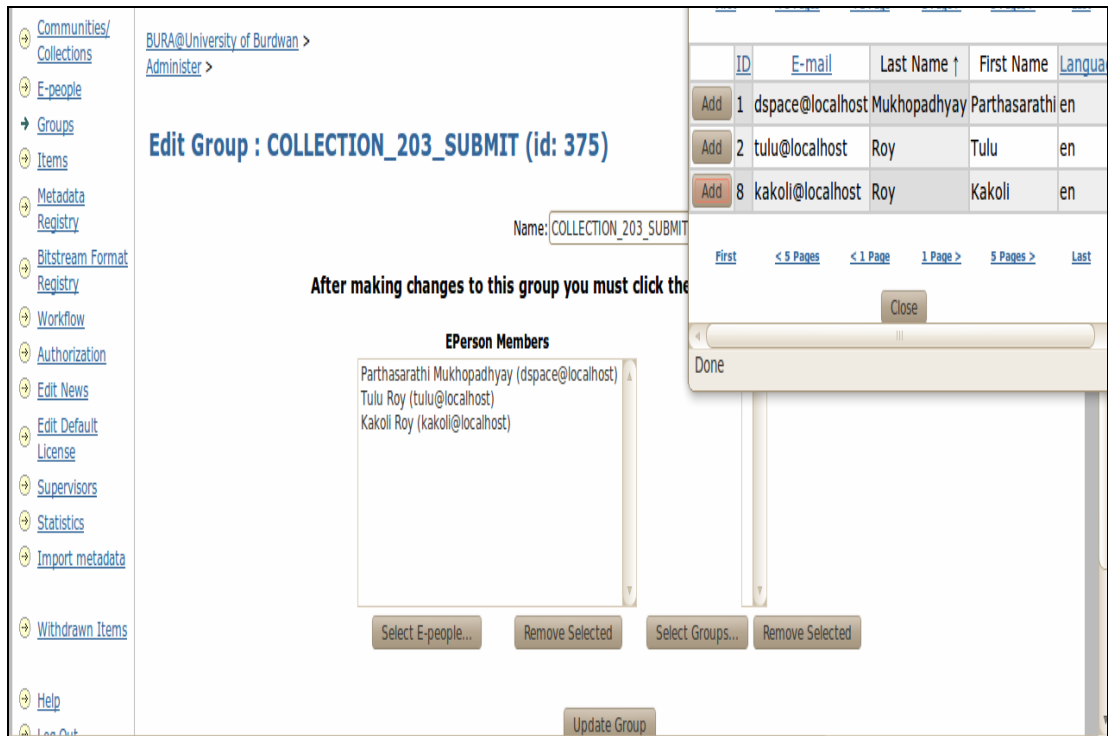


Fig. 6.1.5.8: Display of Submitter's List

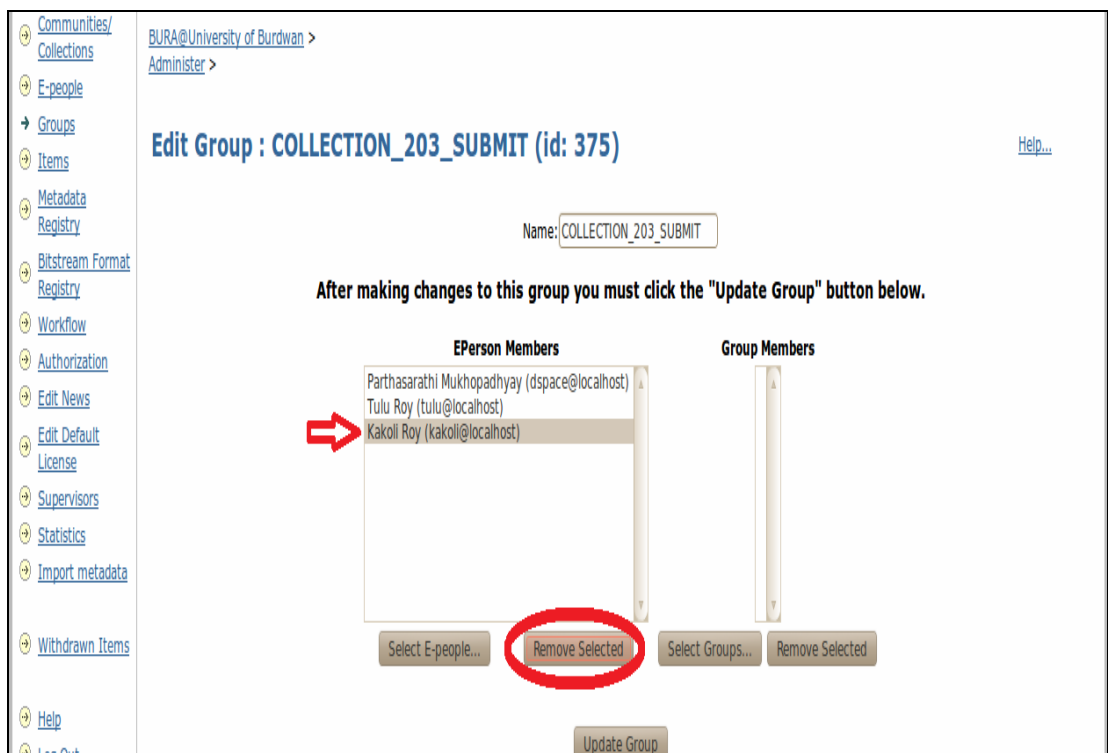


Fig. 6.1.5.9: Submitter's List Modified

In section 4.2.1.12 of chapter 4, this research work recommends three steps in submission workflows having separate E-person(s) for performing specified tasks in different stages of submission of item to the Collection. In each workflow step, the programme generates a small window from where system administrator can pick up appropriate E-person(s) from the list for each workflow step and is shown through six different screen snapshots (Fig. 6.1.5.10 to Fig. 6.1.5.15). The button ‘*Select E-people*’ (Fig. 6.1.5.10) can be clicked to add E-person(s) for the workflow – I.

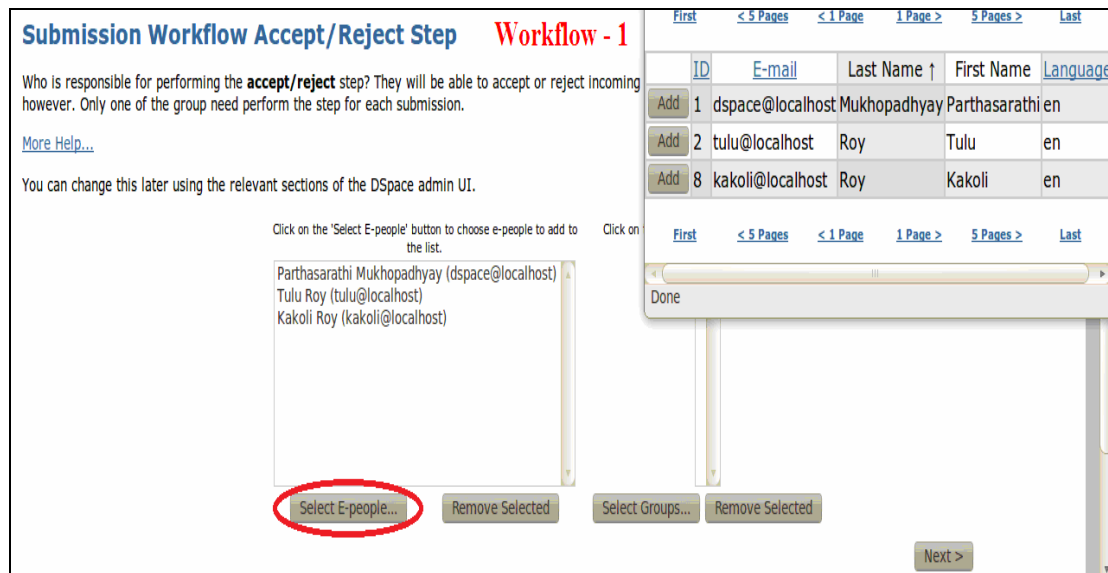


Fig. 6.1.5.10: E-person(s) selection for Workflow 1

A click on ‘*Remove Selected*’ button (Fig. 6.1.5.11) removes selected E-person(s) from the workflow – I.

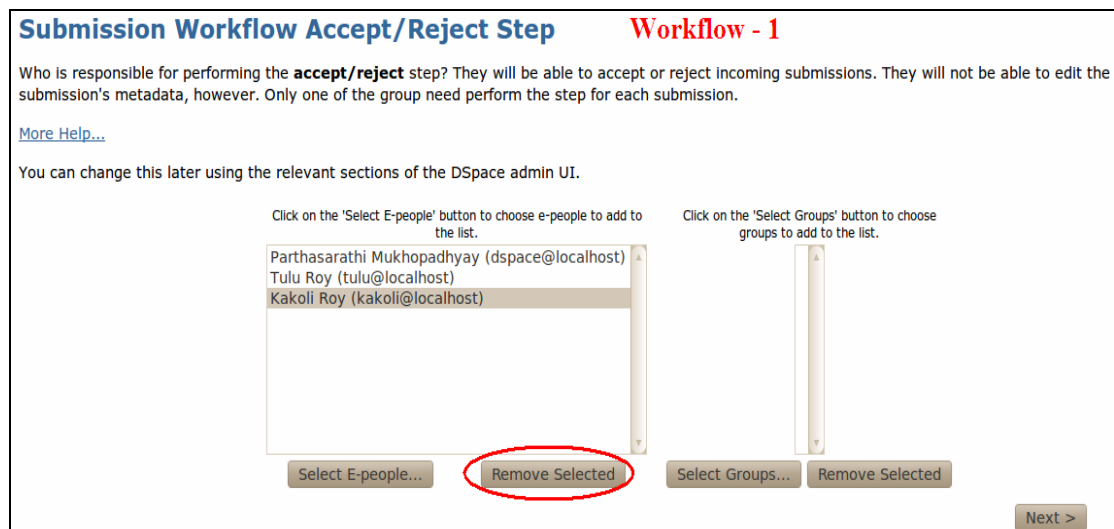


Fig. 6.1.5.11: Removal of E-person for Workflow 1

The button ‘*Select E-people*’ (Fig. 6.1.5.12) can be clicked to add E-person(s) for the workflow – II.

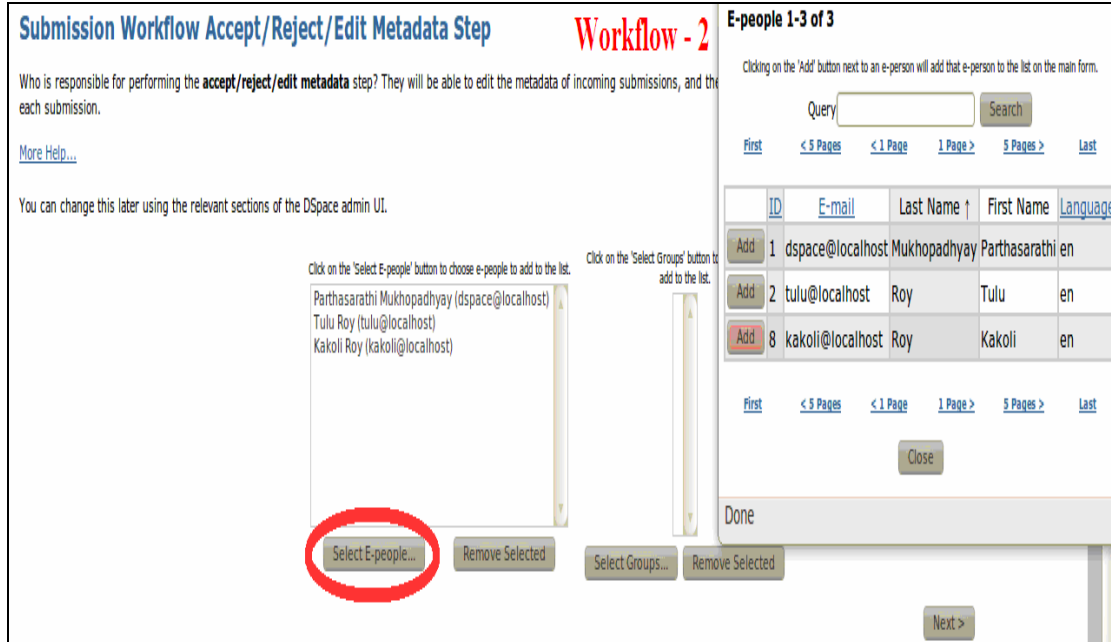


Fig. 6.1.5.12: E-person(s) selection for Workflow 2

A click on ‘*Remove Selected*’ button (Fig. 6.1.5.13) removes selected E-person(s) from the workflow – II.

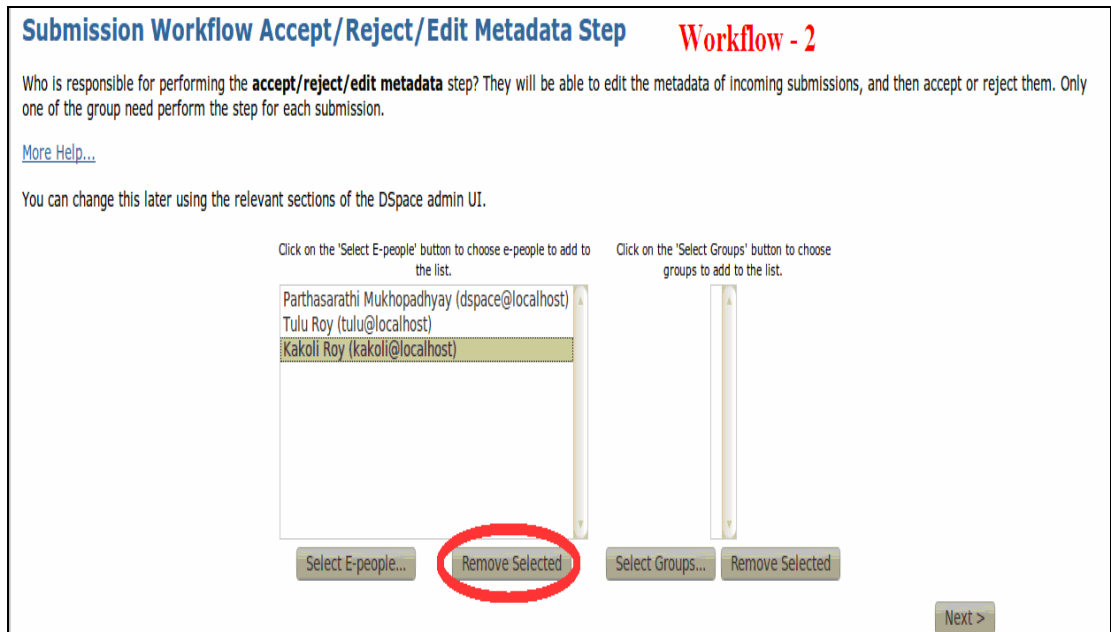


Fig. 6.1.5.13: Removal of E-person for Workflow 2

The button ‘*Select E-people*’ (Fig. 6.1.5.14) can be clicked to add E-person(s) for the workflow – III.

Submission Workflow Edit Metadata Step **Workflow - 3**

Who is responsible for performing the **edit metadata** step? They will be able to edit the metadata of incoming items.

[More Help...](#)

You can change this later using the relevant sections of the DSpace admin UI.

Click on the 'Select E-people' button to choose e-people to add to the list. Click on the 'Remove Selected' button to remove e-people from the list.

Parthasarathi Mukhopadhyay (dspace@localhost)
Tulu Roy (tulu@localhost)
Kakoli Roy (kakoli@localhost)

Select E-people... Remove Selected Select Groups... Remove Selected

ID	E-mail	Last Name ↑	First Name	Language
Add 1	dspace@localhost	Mukhopadhyay	Parthasarathi	en
Add 2	tulu@localhost	Roy	Tulu	en
Add 8	kakoli@localhost	Roy	Kakoli	en

First < 5 Pages < 1 Page 1 Page > 5 Pages > Last

Close

Done

Next >

Fig. 6.1.5.14: E-person(s) selection for Workflow 3

A click on ‘*Remove Selected*’ button (Fig. 6.1.5.15) removes selected E-person(s) from the workflow – III.

Submission Workflow Edit Metadata Step **Workflow - 3**

Who is responsible for performing the **edit metadata** step? They will be able to edit the metadata of incoming items.

[More Help...](#)

You can change this later using the relevant sections of the DSpace admin UI.

Click on the 'Select E-people' button to choose e-people to add to the list. Click on the 'Remove Selected' button to remove e-people from the list.

Parthasarathi Mukhopadhyay (dspace@localhost)
Tulu Roy (tulu@localhost)
Kakoli Roy (kakoli@localhost)

Select E-people... **Remove Selected** Select Groups... Remove Selected

ID	E-mail	Last Name ↑	First Name	Language
Add 1	dspace@localhost	Mukhopadhyay	Parthasarathi	en
Add 2	tulu@localhost	Roy	Tulu	en
Add 8	kakoli@localhost	Roy	Kakoli	en

First < 5 Pages < 1 Page 1 Page > 5 Pages > Last

Close

Done

Next >

Fig. 6.1.5.15: Removal of E-person for Workflow 3

6.1.6. Deletion of Collection

Repository manager can delete a Collection by clicking on 'Edit' button (Fig. 6.1.5.7) at the right corner of the window. A click on 'Delete this Collection' button (Fig. 6.1.6) displays another window (Fig. 6.1.6.1) and finally button 'Delete' can be clicked to delete it.

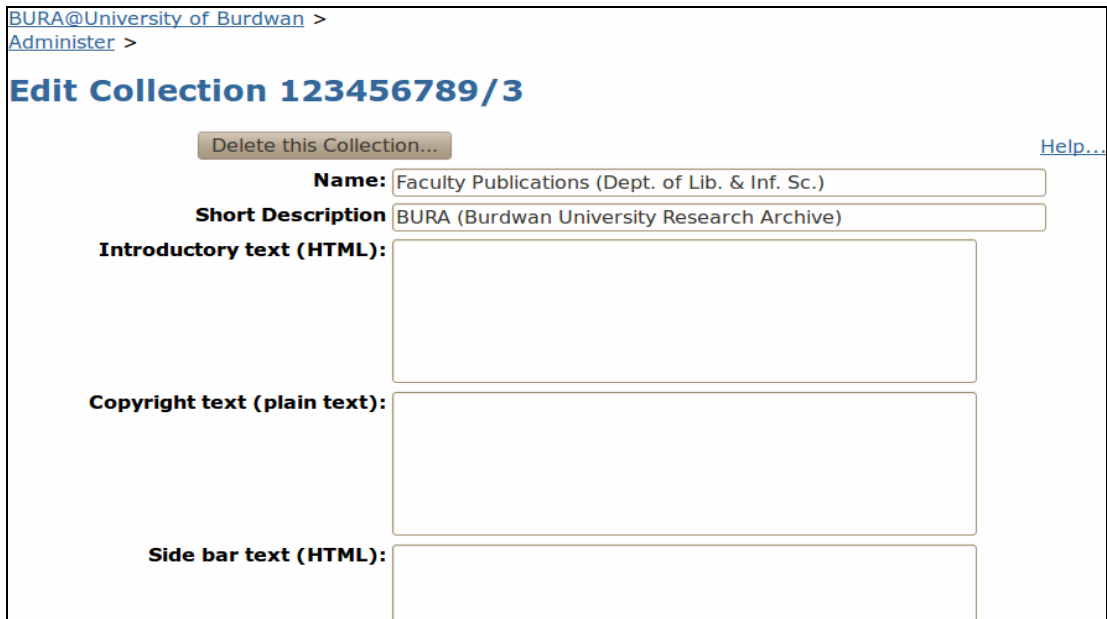


Fig. 6.1.6: Deletion of Collection

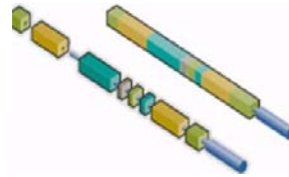


Fig. 6.1.6.1: Collection deleted

6.1.7. Items

Items are one of the core concepts in DSpace. An item is a representation of the files and metadata brought together to make an atomic unit. Each Collection in DSpace Digital Repository is populated with items, also called digital objects or digital documents. An ‘item’ is made up by the following things:

- Metadata;
- Bitstreams; and
- Bundles (e.g. Original/License/Text).



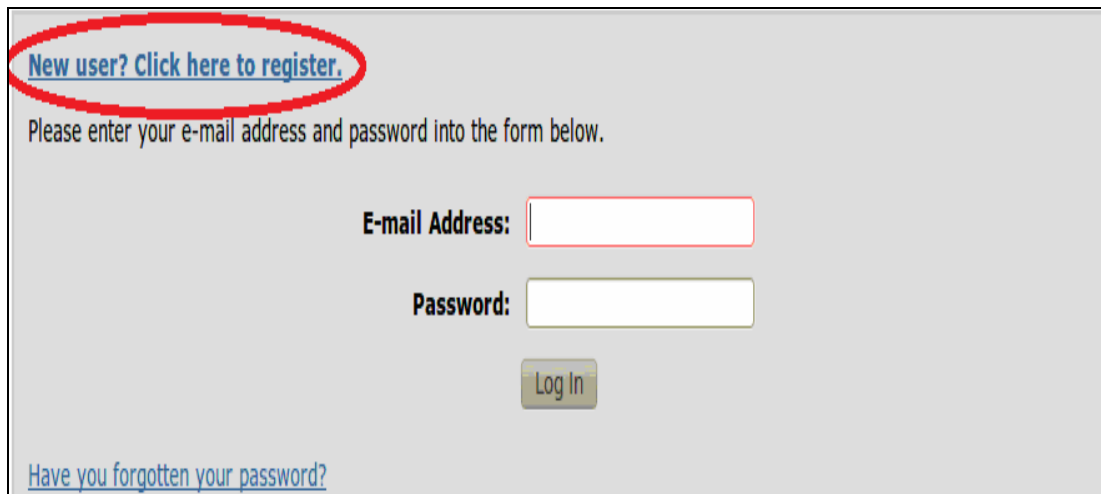
An item may have one or more bitstreams. In other words, an item can be a bundle of bitstreams (e.g. files). Submitter can upload more than one file for single a document. For example, generally thesis consists of many chapters and each chapter is a PDF file, so at the time of uploading all the PDF files together to be considered as one digital item. One can also submit a set of html files and mention which should be considered as the primary file, so that when the digital item is opened by any end-user, the primary file would be displayed first. Later the user can navigate through hyperlinks in the html files. In these cases, each file is considered as a bitstream, and all the files together constitute a digital item.

6.1.8. User Registration in BURA

Registration of users is mandatory in BURA. Account registration section includes login ID, password, password hint and answer to password (in case password is forgotten). Personal information section includes fields like name, surname, phone etc. After successful registration a user can access and use every facilities of BURA including submission of resources. The process of user registration in BURA includes two other associated facilities – modification of user profile and help authorized user to retrieve forgotten password or to set a new password, if required. Modification of user profile facility can be utilized to change user related data including login and password through resubmission of modified member login form. The forgotten password link allows users to retrieve the forgotten password or to set a new password.

A. Becoming a member of BURA

In section 4.2.1.3 of chapter 4, this research work recommends that the person associated with the University of Burdwan can be the member of the System (BURA) and can avail all facilities of the system. The process of user registration is demonstrated here through eight screen snapshots (Fig. 6.1.8 through Fig. 6.1.8.7). It begins with clicking of 'New user? Click here to register' button (Fig. 6.1.8) and putting E-mail ID in appropriate box (Fig. 6.1.8.1).



[New user? Click here to register.](#)

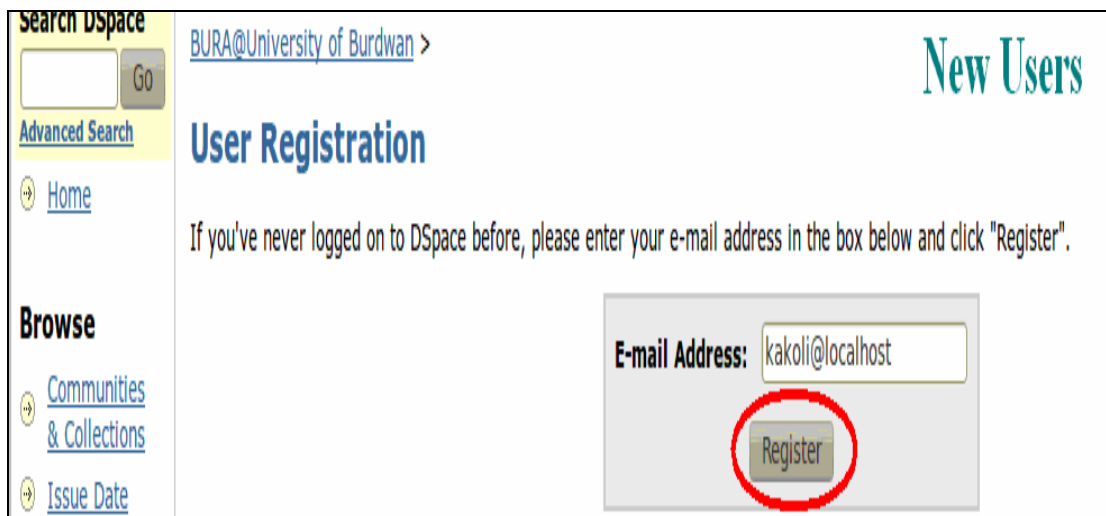
Please enter your e-mail address and password into the form below.

E-mail Address:

Password:

[Have you forgotten your password?](#)

Fig. 6.1.8: Login as a New User



Search DSpace

[Advanced Search](#)

[Home](#)

Browse

[Communities & Collections](#)

[Issue Date](#)

BURA@University of Burdwan >

New Users

User Registration

If you've never logged on to DSpace before, please enter your e-mail address in the box below and click "Register".

E-mail Address:

Fig. 6.1.8.1: User Registration E-mail

The system generates a small window (Fig. 6.1.8.2) displaying the message that E-mail has been sent successfully to the user.



Fig. 6.1.8.2: User Registration E-mail sent

In the next logical step, the mail sent by the system administrator has to be opened (<http://localhost/webmail/>) through E-mail ID and password (Fig. 6.8.1.3).



Fig. 6.1.8.3: Log in to Squirrel Mail

The message showing '*DSpace Account Registration*' (Fig. 6.8.1.4) can be clicked to have the link (Fig. 6.8.1.5).

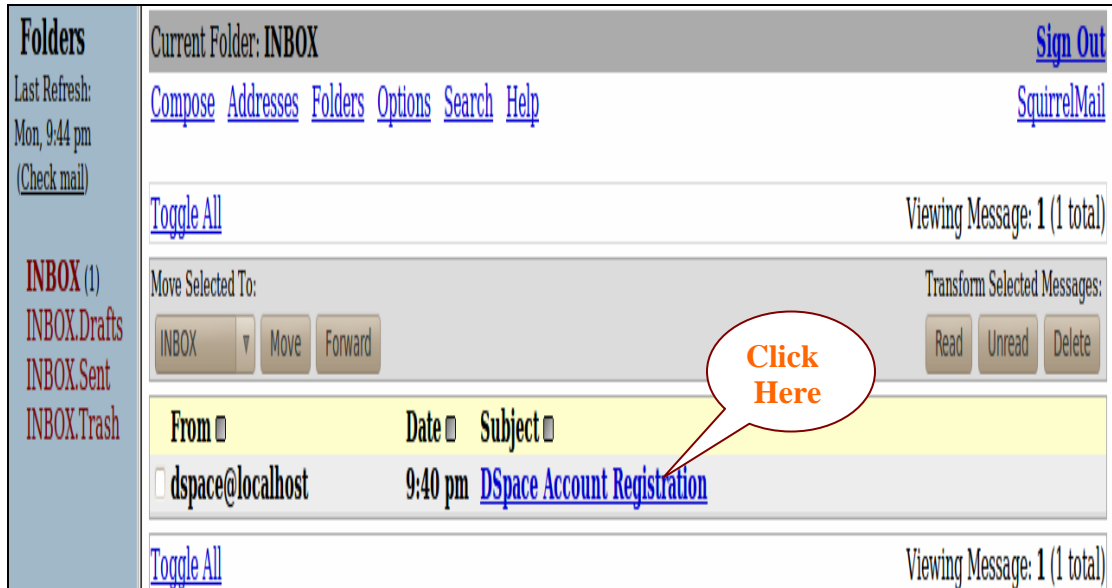


Fig. 6.1.8.4: Account Registration

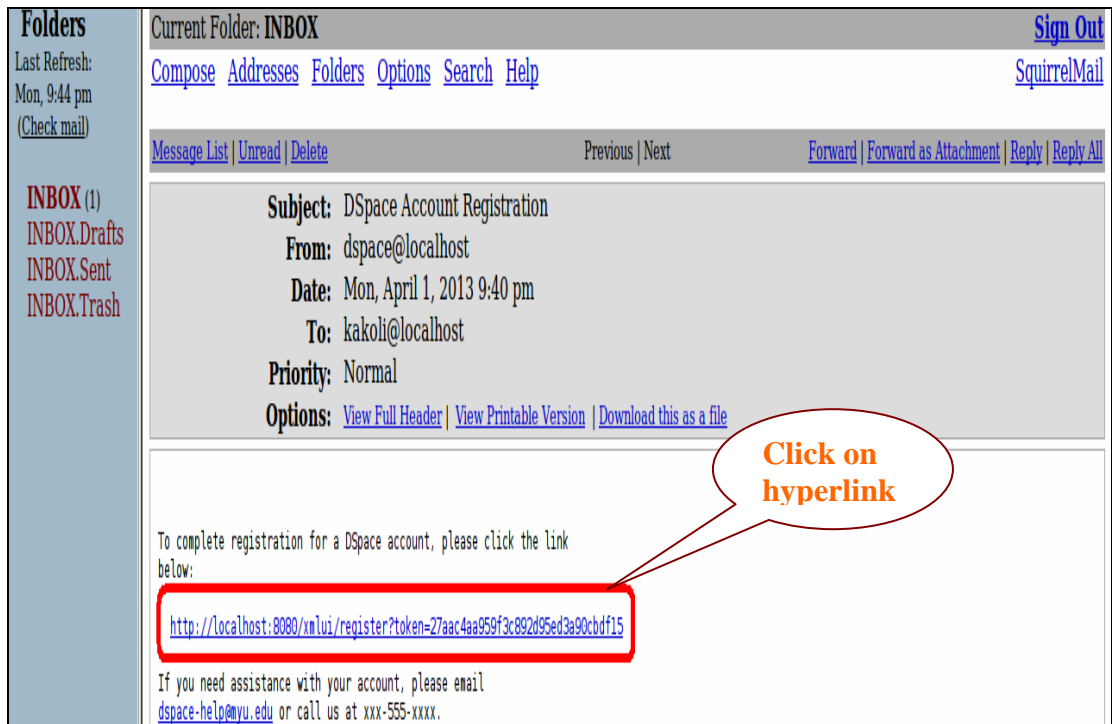


Fig. 6.1.8.5: Account Registration Link

The registration form (Fig. 6.8.1.6) can be displayed by clicking on this link (URL) and finally clicking of 'Complete Registration' button thereon indicates user registration process is completed (Fig. 6.1.8.7).

[Advanced Search](#)

[Home](#)

Browse

[Communities & Collections](#)

[Issue Date](#)

[Author](#)

[Title](#)

[Subject](#)

Sign on to:

[Receive email updates](#)

[My DSpace authorized users](#)

[Edit Profile](#)

Registration Information

Please enter the following information. The fields marked with a * are required.

First name*:

Last name*:

Contact telephone:

Language: English ▾

Please choose a password and enter it into the box below, and confirm it by typing it again into the second box. It should be at least six characters long.

Password:

Again to Confirm:

Fig. 6.1.8.6: User Registration Form

Search DSpace

[Advanced Search](#)

[Home](#)

Browse

[Communities & Collections](#)

[Issue Date](#)

[Author](#)

[Title](#)

[Subject](#)

[BURA@University of Burdwan >](#)

Registration Complete

Thank you Kakoli,

You're now registered to use the DSpace system. You can subscribe to collections to receive e-mail updates about new items.

[Return to DSpace Home](#)

Fig. 6.1.8.7: User Registration Completed

6.1.9. Password Management

This part is only for authorized user of the system and BURA allow authorized user(s) changing logging password. The following steps are to be followed if the password entered by authorized user is wrong or password has been forgotten or E-mail entered by user is found wrong. The process of changing password is shown here through five screen snapshots (Fig. 6.1.9 through Fig. 6.1.9.4). The moment administrator clicks on ‘*Have you forgotten your password?*’ button (Fig. 6.1.8), another window (Fig. 6.1.9) will be displayed and allows user entering E-mail which had been used at the time of registration.

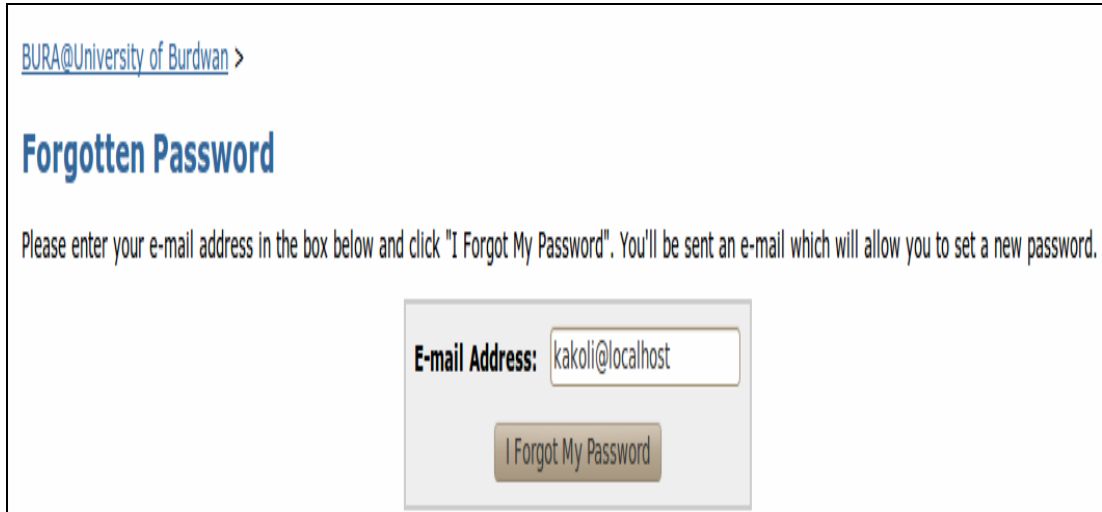


Fig. 6.1.9: E-mail for Forgotten Password

Corresponding E-mail containing message about changing password will be sent to the user. A click on ‘*I Forgot My Password*’ option (Fig. 6.1.9) displays the subsequent window (Fig. 6.1.9.1) that indicates new password E-mail has been to the user.

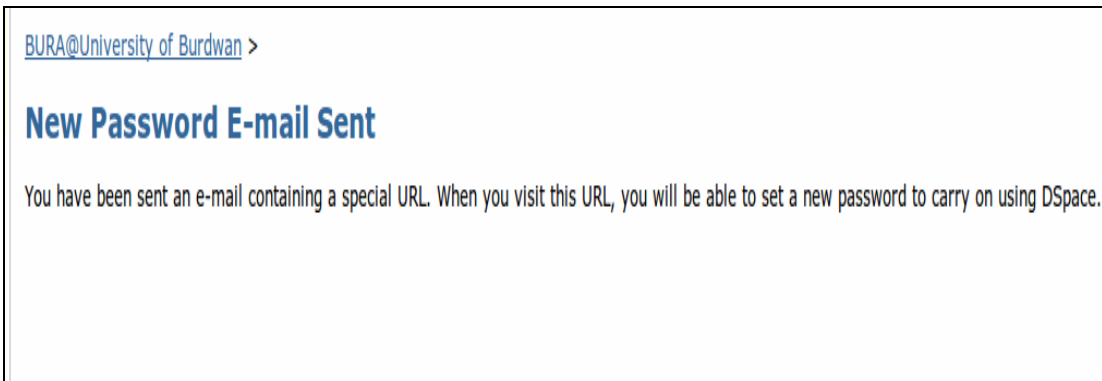


Fig. 6.1.9.1: New Password E-mail

A click on this message ‘*Change Password Request*’ (Fig. 6.1.9.2) allows user to set the new password.

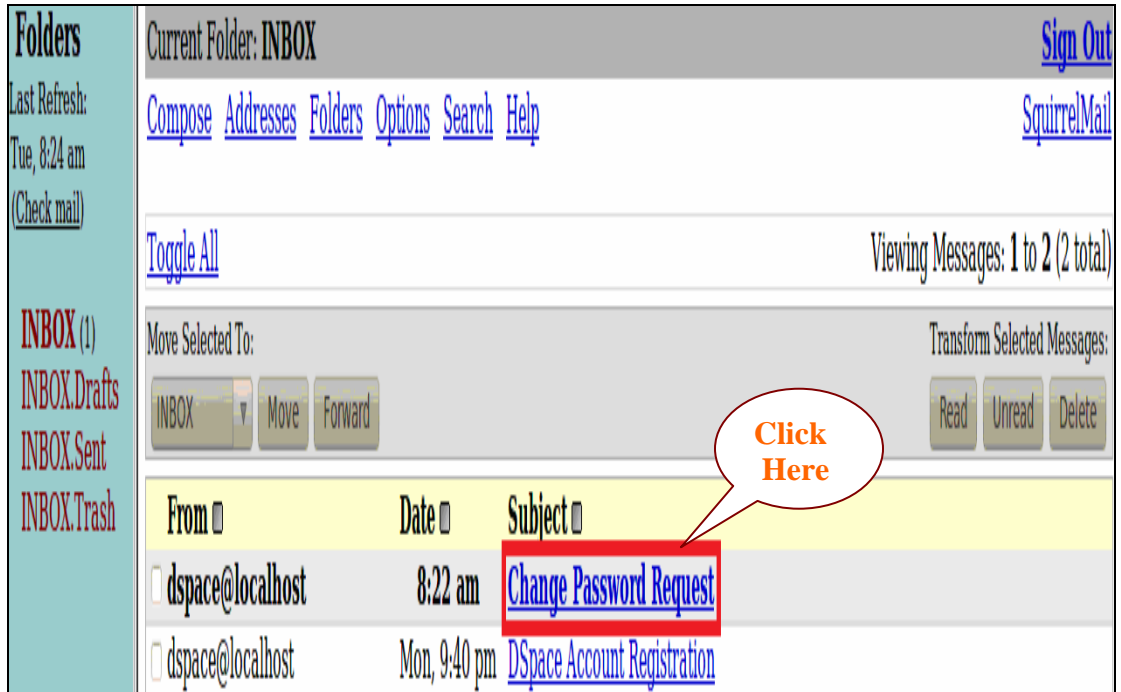


Fig. 6.1.9.2: Change Password

The moment user clicks on ‘*Set New Password*’ button (Fig. 6.1.9.3), password will automatically be changed (Fig. 6.1.9.4).

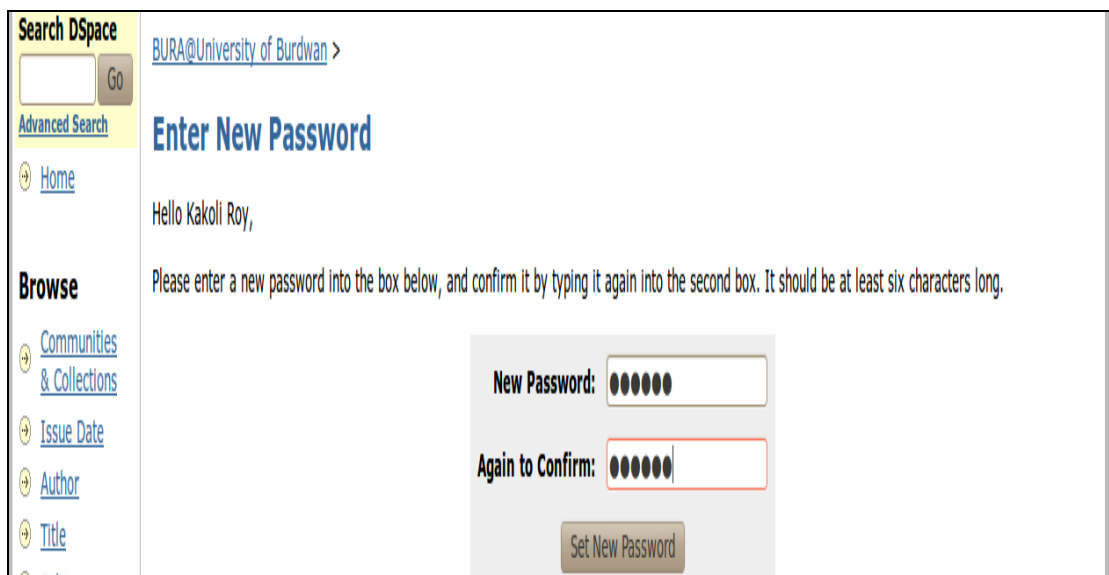


Fig. 6.1.9.3: Enter New Password

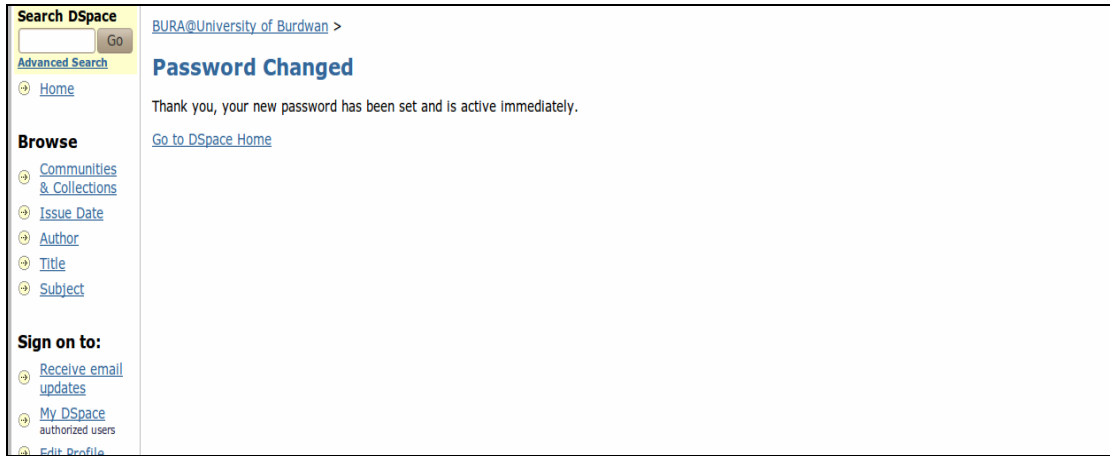


Fig. 6.1.9.4: Password changed

6.1.10. Mail Management

Once an item is submitted to a Collection in BURA sends an E-mail notification to the concerned E-people(s) (e.g. submitter, reviewer, metadata editor). All the E-persons playing different roles in submission process (vide section 4.2.1.12 of chapter 4) will be informed by mail to perform their individual tasks to complete the process. For example, kakoli is performing two roles – (i) *Submitter*; and (ii) *Metadata editor* in the Collection (Here Faculty Publication - Dept. of Lib. & Inf. Sc.). Two separate mails (Fig. 6.1.10 & Fig. 6.1.10.1) will be sent to the concerned E-person (kakoli) of which one mail is for ‘*Submitter*’ and another mail is for ‘*Metadata editor*’ to that particular Collection.

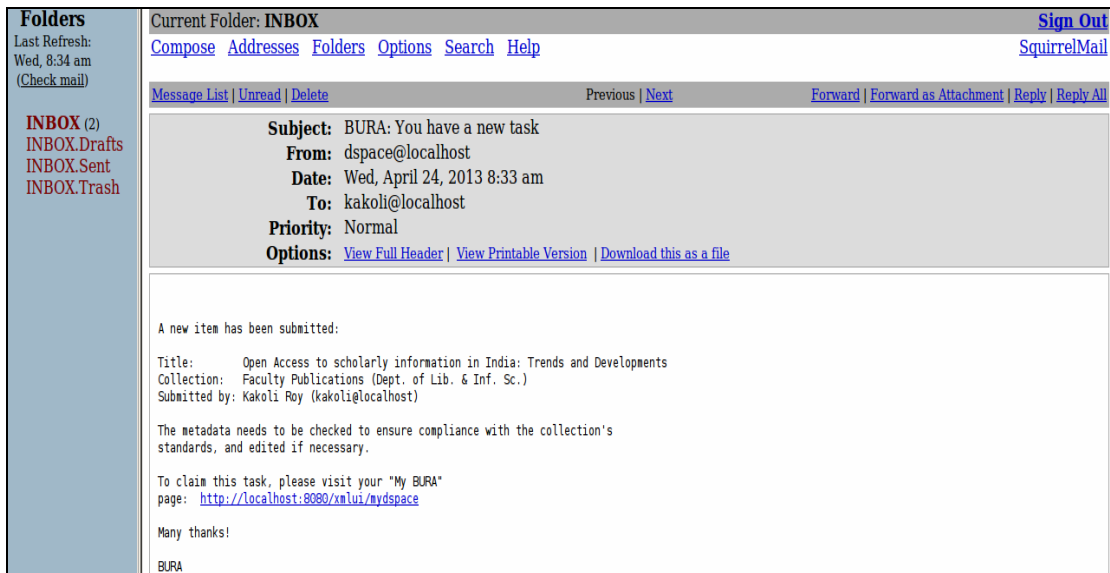


Fig. 6.1.10: Mail received as Submitter

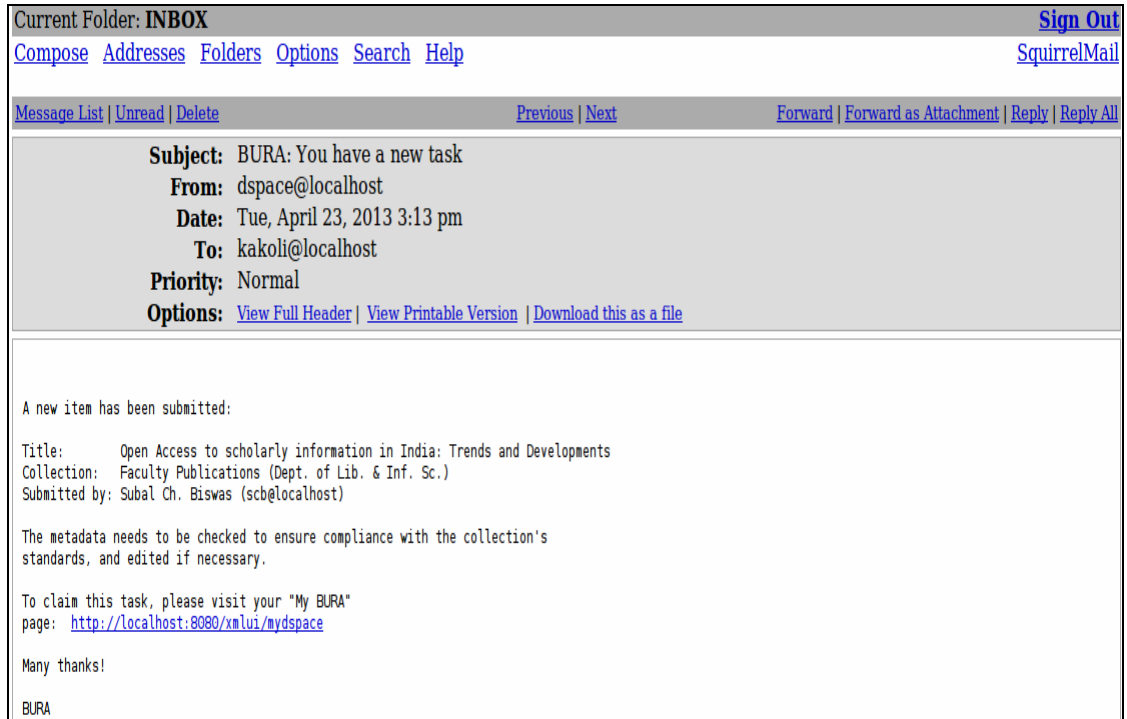


Fig. 6.1.10.1: Mail received as Metadata Editor

6.1.11. Editing Profile

BURA has a provision to update or edit profile information of authorized users and it can be done by clicking 'Edit Profile' button at the left hand side of the window (Fig. 6.1.1) and is shown through two screen snapshots (Fig. 6.1.11 & Fig. 6.1.11.1). The form (Fig. 6.1.11.1) can be displayed after clicking on 'Log In' button (Fig. 6.1.11). Once updating is completed, button 'Update Profile' (Fig. 6.1.11.1) can be clicked to save the data.

[New user? Click here to register.](#)

Please enter your e-mail address and password into the form below.

E-mail Address:

Password:

Fig. 6.1.11: Edit Profile: Log in

Edit Your Profile

Please enter or amend the following information. The fields marked with a * are required. [More Help...](#)

First name*:

Last name*:

Contact telephone:

Language:

Optionally, you can choose a new password and enter it into the box below, and confirm it by typing it again into the second box for verification. It should be at least six characters long.

New Password:

Again to Confirm:

Fig. 6.1.11.1: Profile Updated

6.1.12. E-Person(s) Management

DSpace calls users '*E-people*'. Normally, anyone can become a member of BURA using '*My DSpace*' in the left hand side menu of the first screen of the window. However, it is desirable to have some initial members, who can take the responsibility of reviewing and approving of contents. Though it is not mandatory to have members initially, to configure a repository for the first time, it is convenient to create some members or groups. When Community and Collection are created, the process can be completed by assigning who or which group is authorized to submit or review or modify metadata (vide section 4.2.1.12 of chapter 4). The system (BURA) holds the following information about each E-person -

- E-mail address;
- Phone number;
- First and last names;
- A password (encrypted), if appropriate; and
- A list of collections for which the e-person wishes to be notified of new items.

The process of managing E-person(s) is shown here through five screen snapshots (Fig. 6.1.12 through Fig. 6.1.12.4). The moment '*E-people*' button (Fig. 6.1.1.1) is clicked, the system displays the window (Fig. 6.1.12) having three options and system administrator can select any one of the three operations by clicking on appropriate

button. This ‘Add E-Person’ button (option 1) can be clicked here to add a new E-person to the system and finally ‘Save’ button (Fig. 6.1.12.1) can be clicked to save it. This window can also be used to edit information about the E-person.

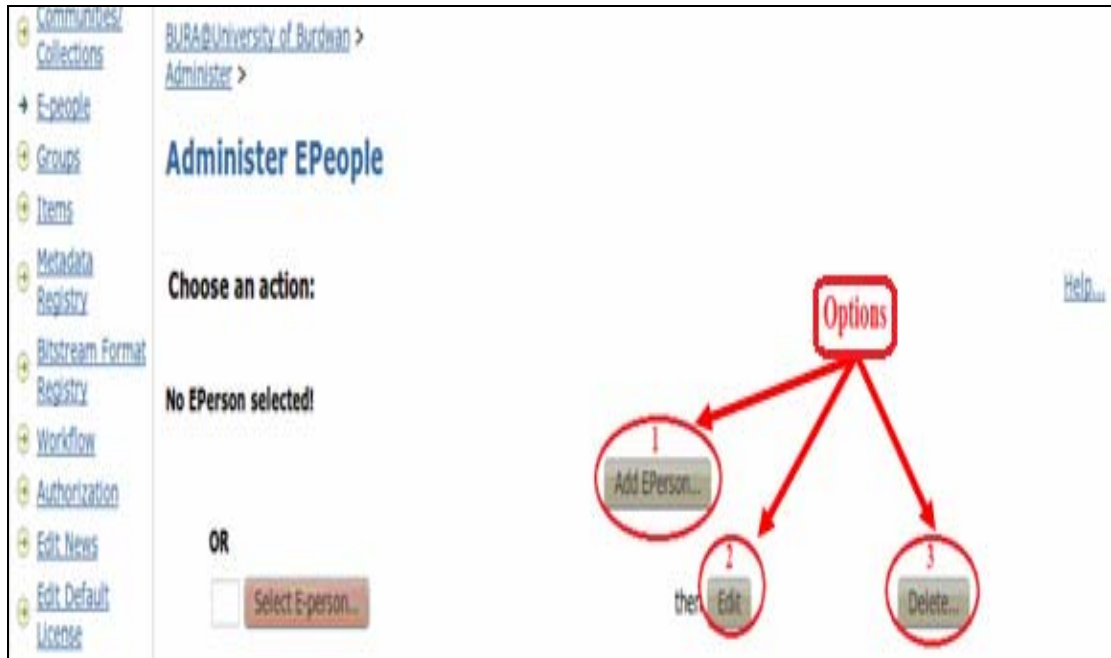


Fig. 6.1.12: Add E-Person



Fig. 6.1.12.1: E-Person Form

The programme generates a small window (Fig. 6.1.12.2) showing all E-person(s) in the system and repository administrator after selecting E-person(s) from the list can delete E-person(s) by clicking of 'Delete' button (Fig. 6.1.12.3).



Fig. 6.1.12.2: Delete E-Person

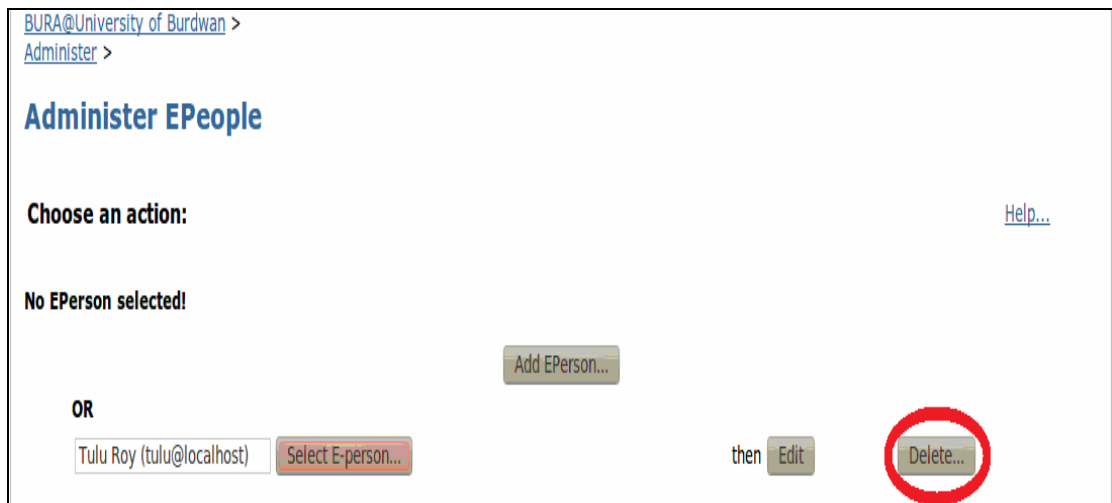


Fig. 6.1.12.3: Delete selected E-Person

And finally it will be prompted to confirm the deletion of selected E-person(s) (Fig. 6.1.12.4).



Fig. 6.1.12.4: E-Person Deleted

6.1.13. Registering E-person as an Administrator

The system allows E-person(s) to be registered as administrator to perform various operations in BURA. E-person(s) having in the list can be added as administrator and new group for the system can be created by clicking of ‘Groups’ button (Fig. 6.1.13) in the left hand corner of the window.

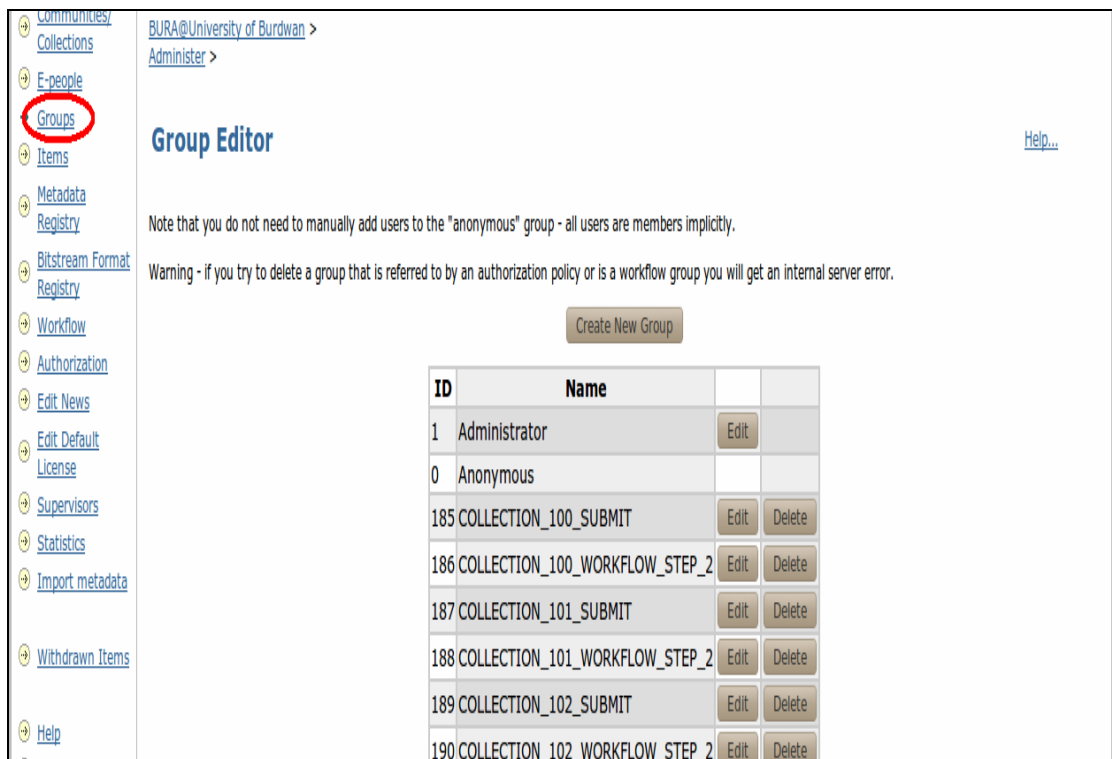


Fig. 6.1.13: Group Editor

This administrator(s) list can be modified by clicking on ‘*Edit*’ button (Fig. 6.1.13.1) and is shown here in two screen snapshots (Fig. 6.1.13.2 & Fig. 6.1.13.3).

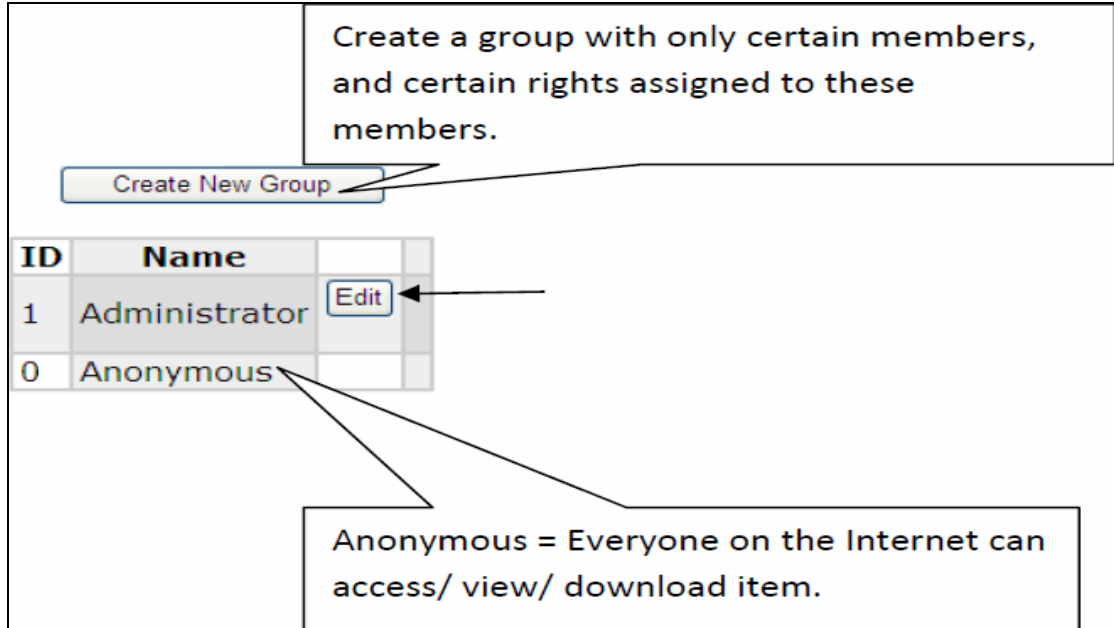


Fig. 6.1.13.1: Administrator Group

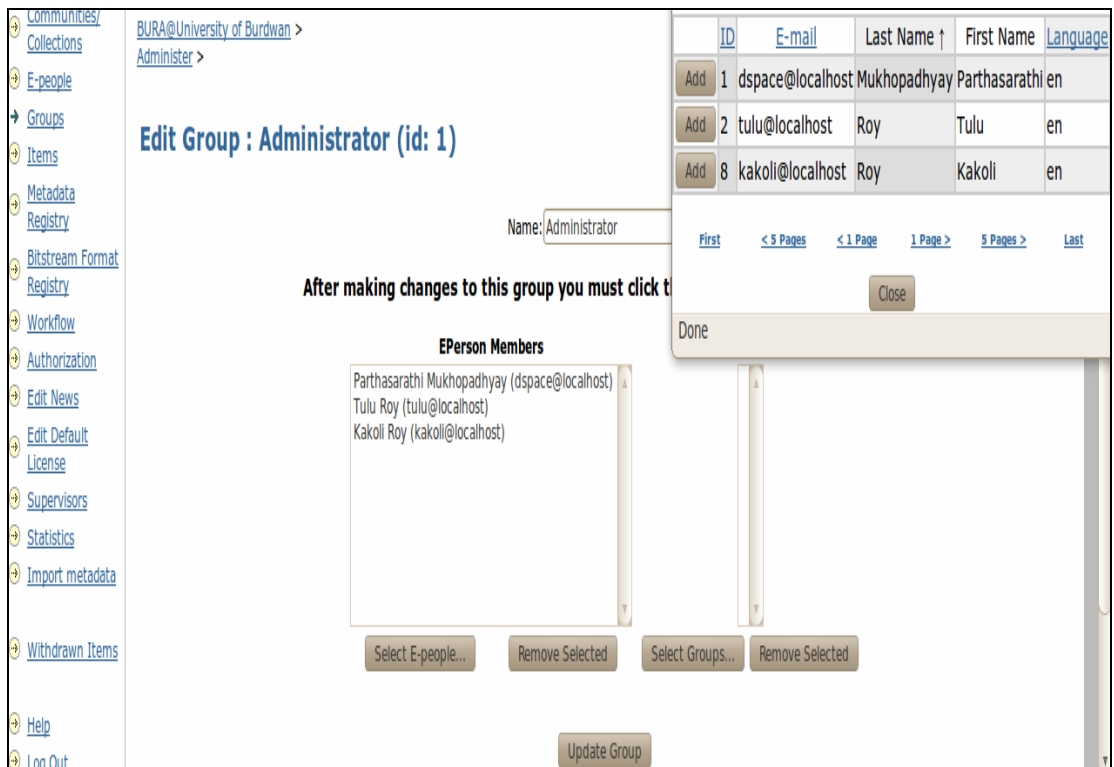


Fig. 6.1.13.2: Administrator Group selected

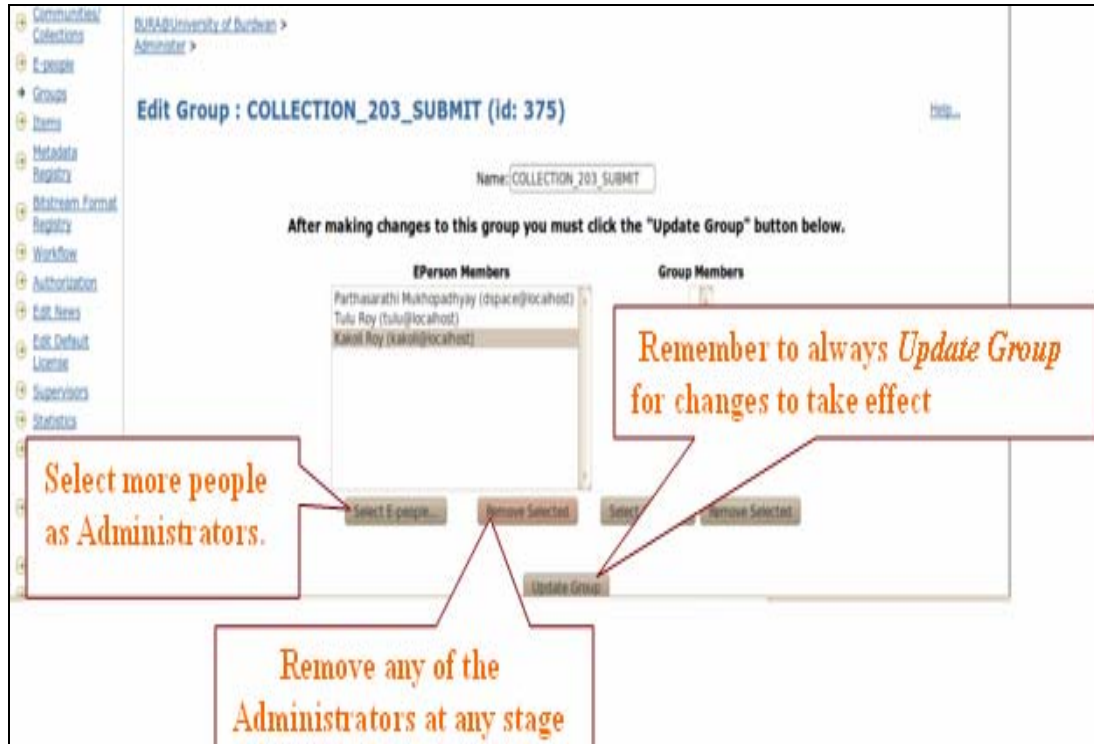


Fig. 6.1.13.3: Explanation of Function Keys

6.1.14. Workflow Management

In section 4.2.1.12 of chapter 4, this study recommends workflow policy of BURA and interface (Fig. 6.1.14) given below allows administrator to select E-person(s) or Groups for different workflow steps designed for the Collection. Another window (Fig. 6.1.14.1) shows the lay out of submission workflow with framework sheet.

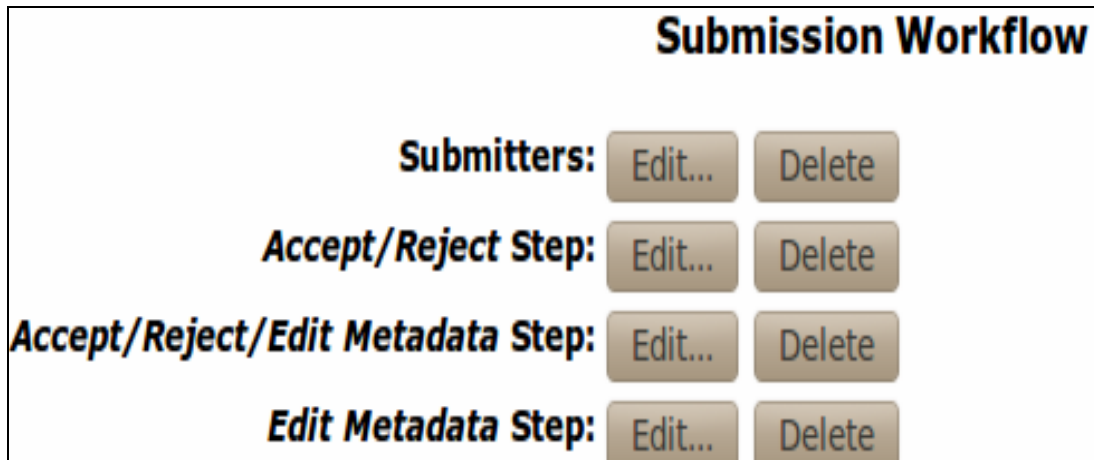


Fig. 6.1.14: Submission Workflow

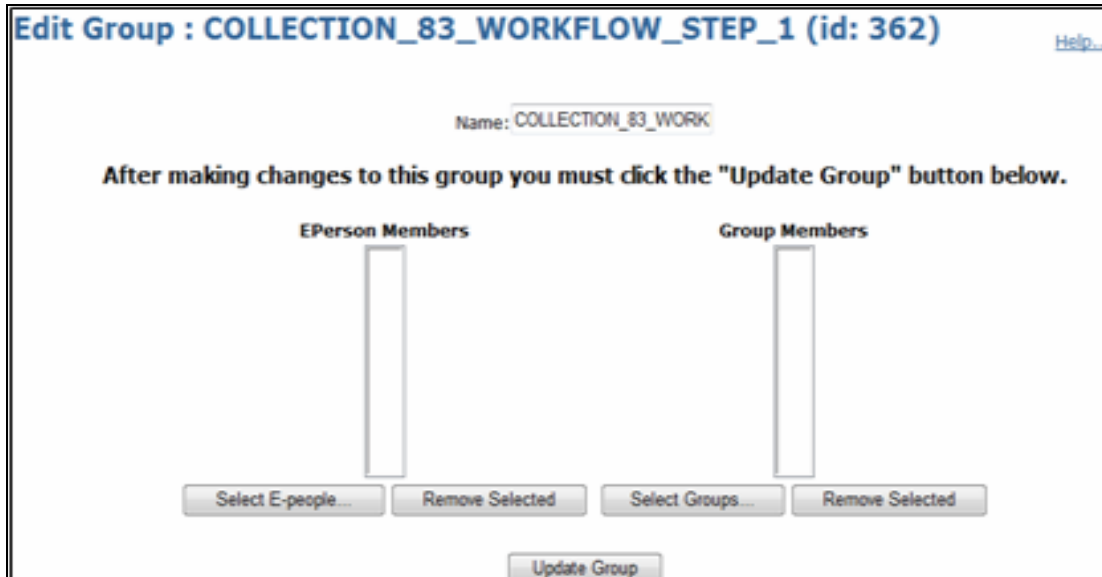


Fig. 6.1.14.1: Submission Workflow Framework Sheet

6.1.15. Item Mapping

Item mapping facilities has been providing in Dspace (version 1.2 onward). Items can appear in more than one Collection especially when subjects are interdisciplinary in nature and covers more than one discipline (i.e. Biochemistry, Biotechnology). The tool that 'maps' items to Collections other than the one that owns it is the "Item Mapper". Repository manager can pick up appropriate Collection to be mapped an item from another Collection. Repository manager can view search box (Fig. 6.1.15) by clicking on 'Item Mapper' button (Fig. 6.1.5.7) and the window (Fig. 6.1.15.1) displays the matched item.



Fig. 6.1.15: Authors search by Surname

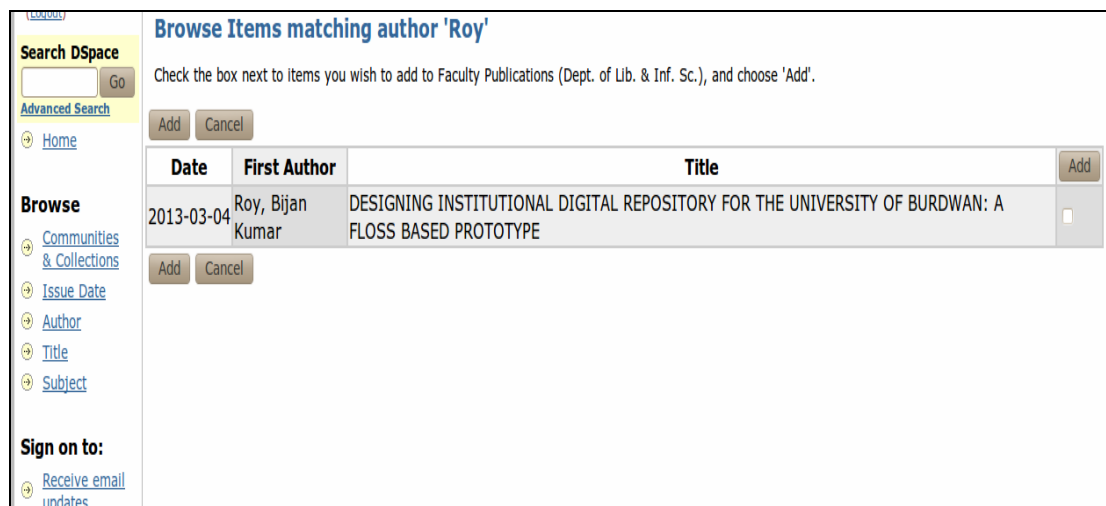


Fig. 6.1.15.1: Display of Matching Item

6.1.16. Submission Process in BURA

BURA offers an easy-to-use Web-based process for submitting digital works one by one to an established Collection. BURA supports not only distributed access of resources from anywhere at anytime but also extends scope to submit resources over the Web. BURA allows remote submission of resources through authorized users. Provision of remote submission of resources by authorized users truly characterizes the distributed nature of IDR system. The process of remote submission in BURA is password authenticated to ensure credibility of information providers. Once logged in, user can click the "Submissions" link in the 'My DSpace' section and will find:

- a list of his/her in-progress submissions - from this list he/she can resume the submission process where he/she left off, or he/she can remove the submission and cancel the work;
- a list of the submissions which he/she is supervising or collaborating on;
- a list of submissions that are awaiting his/her action (if he/she have a collection workflow role); and
- a link to a list of works that he/she has submitted and that has already been accepted into the repository.

Submitting a work to the BURA is a multi-step process. The process of submission includes 7 (seven) different steps starting from selection of Collection, filling out information about the work on a form and uploading the file(s) comprising the digital work etc. At any point in the submission process submitter can stop and save the work for a later date by clicking on the 'Cancel/Save' button at the bottom of that page. The data already entered by the submitter will be stored until submitter returns to the submission, and submitter will be reminded through 'My DSpace' page that an item has been in submission in process. If some how accidentally exits from the

submission process, submitter can always resume submission from ‘My DSpace’ page.

A. Submission Progress Bar

The ‘Submission Progress Bar’ (Fig. 6.1.16) is a set of grey buttons at the top of the ‘Submit page’. As submitter move through the process, these ovals will be activated. Once it is started, submitter can also use these buttons to move back and forth within the submission process by clicking on it. Data will remain intact even moving back and forth. This ‘chain’ appears at the top of all the succeeding screens. The node in ‘red’ indicates the current screen of the seven (7) screens.

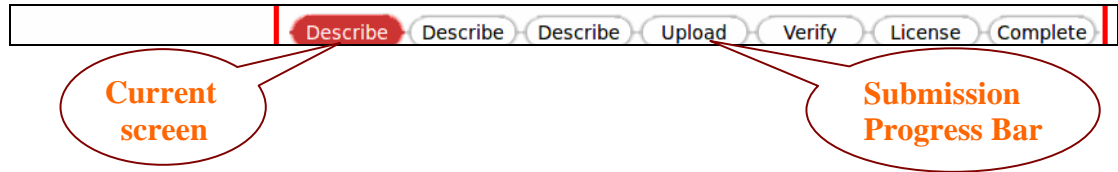


Fig. 6.1.16: Submission Progress Bar

B. Start a New Submission

This section gives step-by-step instructions of the submission process of BURA. The whole process of submission is shown here through fifteen screen snapshots (Fig. 6.1.16.1 through Fig. 6.1.16.15). It can be done both by going to – (a) ‘Collection page’ (options given is ‘Faculty Publications - Dept. of Lib. & Inf. Sc.’) and clicking on the ‘Submit to This Collection’ button (Fig. 6.1.16.1) or by logging/or going to the (b) ‘My DSpace’ (Fig. 6.1.16.2) and clicking on the ‘Start a New Submission’ button (Fig. 6.1.16.3).

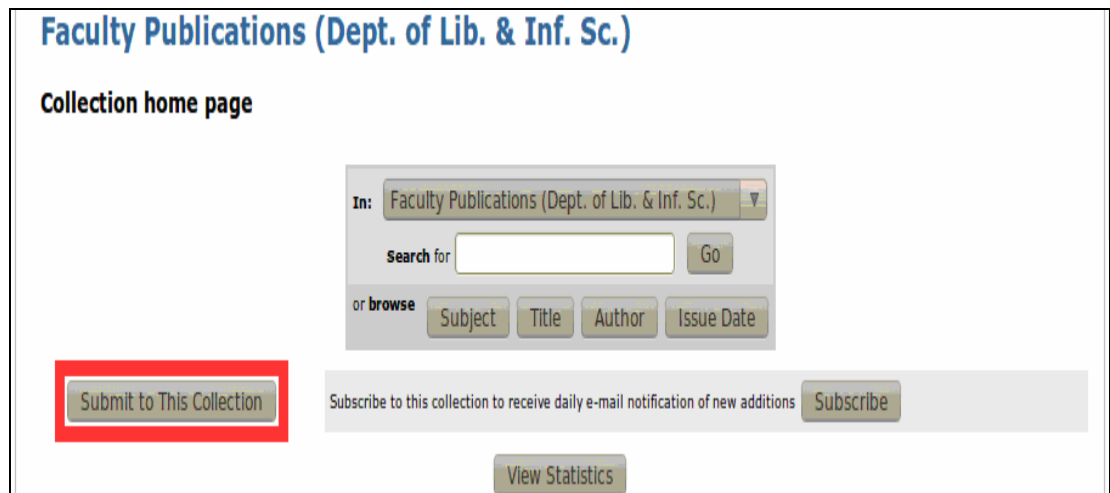


Fig. 6.1.16.1: Submission Collection Page

[New user? Click here to register.](#)

Please enter your e-mail address and password into the form below.

E-mail Address:

Password:

Fig. 6.1.16.2: Submission: Log in ID & Password

Logged in as [kakoli@localhost](#)
([Logout](#))

[BURA@University of Burdwan >](#)

Search DSpace

[Advanced Search](#)

[Home](#)

My DSpace: Kakoli Roy

[Help...](#)

[See Your Subscriptions](#)

Fig. 6.1.16.3: New Submission Interface

The interface (Fig. 6.1.16.4) displays all the Collections submitter is authorized to submit and is supported by drop down menu lists from where submitter can select desired Collection.

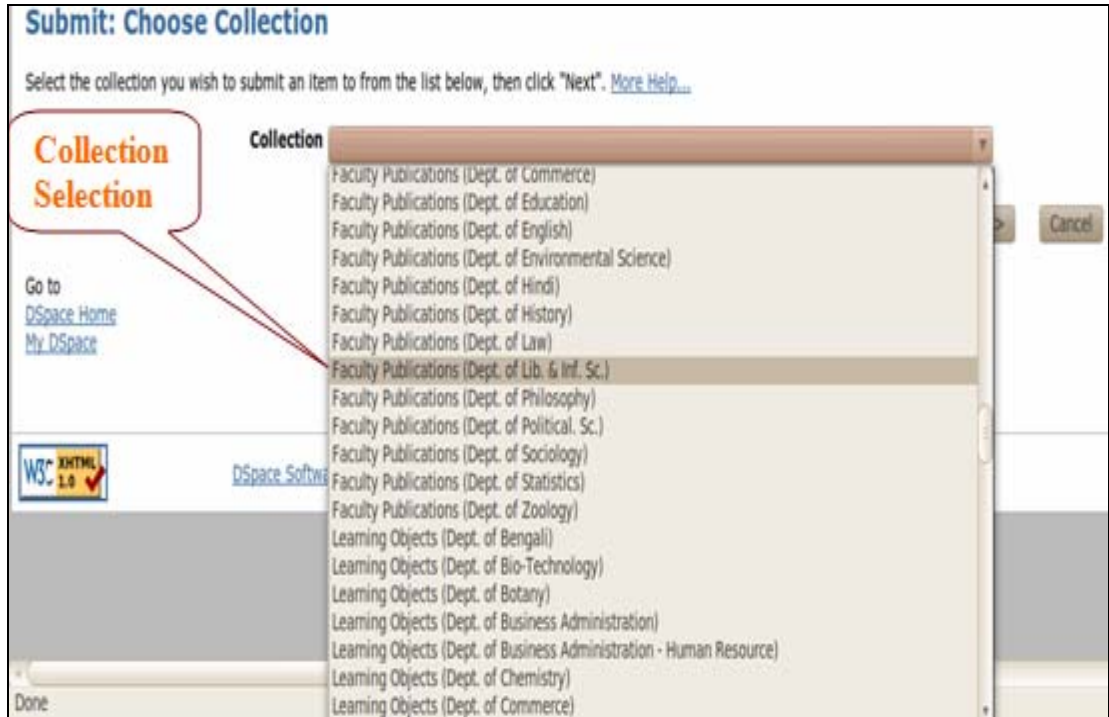


Fig. 6.1.16.4: Selection of Collection

The first deposit page (Fig. 6.1.16.5) displays three options and if none of these questions apply, submitter can click on 'Next' button to go to the next succeeding screens (Fig. 6.1.16.6).

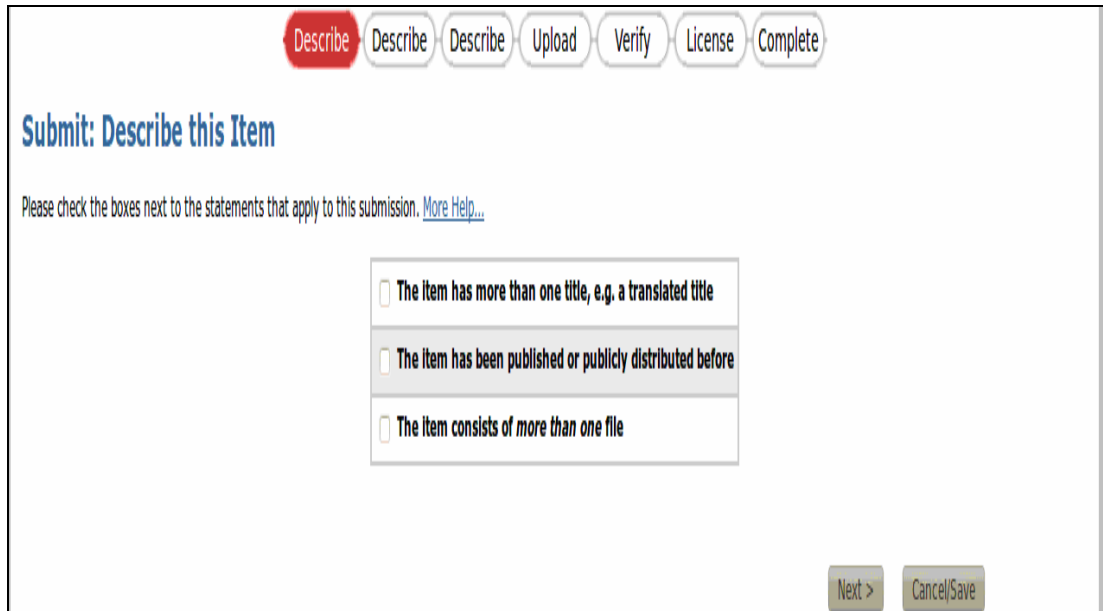


Fig. 6.1.16.5: Item Description

This window (Fig. 6.1.16.6) allows submitter to enter metadata in required fields one-by-one. Some of these fields are mandatory and some are repeatable and ‘Next’ button can be clicked once it is done.

The screenshot shows a web form titled "Submit: Describe this Item" with a "Submission Form" section. At the top, there are buttons: "Describe" (highlighted in red), "Describe", "Describe", "Upload", "Verify", "License", and "Complete". Below the title, there is a instruction: "Please fill in the requested information about this submission below. In most browsers, you can use the tab key to move the cursor to the next input box or button, to save you having to use the mouse each time. (More Help...)"

The "Submission Form" section includes:

- Authors:** A table with columns "Last name" (e.g. Smith) and "First name(s) + 'Jr'" (e.g. Donald Jr). It contains three rows of input fields with values "Roy", "B. K", "Biswas", "S. C", and "Mukhopadhyay", "P". A "Remove This Entry" button is next to the first row, and an "Add More" button is at the bottom right of the table. A red callout bubble labeled "Mandatory" points to the input fields.
- Title:** A single input field with the value "cess to scholarly information in India: Trends and Developments". A red callout bubble labeled "Repeatability" points to this field.
- Series/Report No.:** Two input fields for "Series Name" and "Report or Paper No.", with an "Add More" button.
- Identifiers:** A dropdown menu for "ISSN" and an "Add More" button.
- Type:** A dropdown menu with options: Animation, Article, Book, Book chapter, Dataset, Learning Object. A red callout bubble labeled "Multiple Selection" points to this menu.
- Language:** A dropdown menu with the value "N/A".

At the bottom of the form, there are navigation buttons: "< Previous", "Next >", and "Cancel/Save".

Fig. 6.1.16.6: Submission Form: Level – 1

The next subsequent windows (Fig. 6.1.16.7A & Fig. 6.1.16.7B) display additional metadata fields like Abstract, Subject Keywords fields and Description etc. In section 4.2.1.2 of chapter 4, this research work recommends use of vocabulary control device for BURA. BURA software framework applied DDC 22nd edition (up to 3rd summary in English and Bengali languages). It can also be used in Bengali (vide section 5.4 of chapter 5). Submitter can view all top level subjects in English as well as in Bengali by clicking on appropriate ‘Subject Categories’. Submitter can navigate throughout

the subject category(ies) and can select any of the top subjects in English as well as in Bengali along with its sub-divisions. The plus sign (+) indicates that category has sub-categories and/or links to resources under it. A click on the (+) sign expands hierarchy under categories and sub-categories. In this way integrated control subject device can be utilized to achieve consistency and desired information at the time of submission and searching.

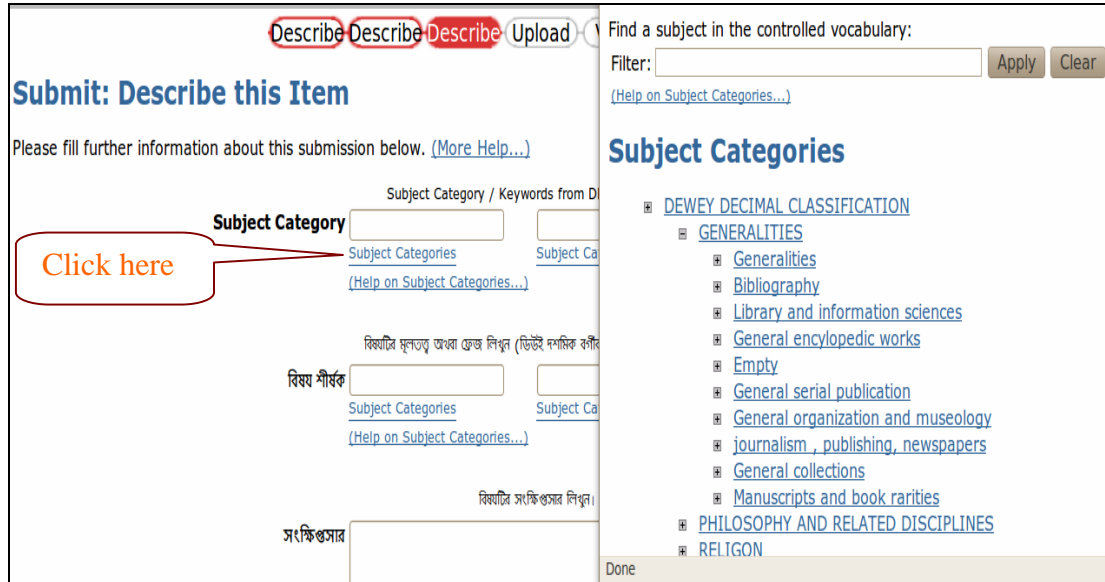


Fig. 6.1.16.7A: Submission Form: Level – 2 (selection of subjects categories - English)

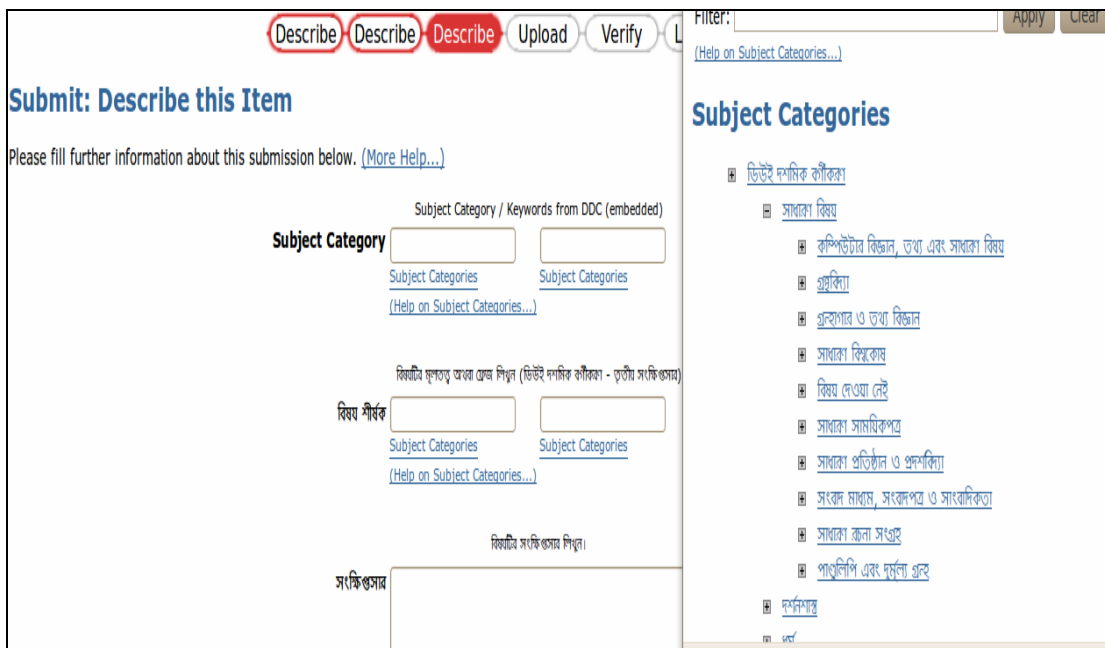


Fig. 6.1.16.7B: Submission Form: Level – 2 (selection of subjects categories - Bengali)

When the data entry work is completed, the next logical step is uploading file (Fig. 6.1.16.8).

Describe Describe Describe **Upload** Verify License Complete

Submit: Upload a File

Please enter the name of the file on your local hard drive corresponding to your item. If you click "Browse...", a new window will appear in which you can locate and select the file on your local hard drive. [More Help...](#)

Please also note that the DSpace system is able to preserve the content of certain types of files better than other types. [Information about file types and levels of support for each are available.](#)

Document File: ||media/8AB24D5EB24D503D/D Drive/Publications/ **Browse...**

Local path of file

< Previous Next > Cancel/Save

Fig. 6.1.16.8: File Uploading

This window (Fig. 6.1.16.9) provides two options and submitter can pick up appropriate action (if required).

Describe Describe Describe **Upload** Verify License Complete

Submit: Uploaded File

Here are the details of the file you have uploaded. Please check the details before going to the next step. [More Help...](#)

File	Size	File Format
IRJLIS June 12.pdf	271,053 bytes	Adobe PDF (known)

Wrong Format Click here if this is the wrong format

Click here if this is the wrong file **Wrong File**

You can verify that the file has been uploaded correctly by:

- Clicking on the filename above. This will download the file in a new browser window, so that you can check the contents.
- The system can calculate a checksum you can verify. [Click here for more information.](#) [Show checksums](#)

< Previous Next > Cancel/Save

Fig. 6.1.16.9: File Verification

A click on the ‘Click here if this is the wrong format’ button (Fig. 6.1.16.10) allows submitter changing format of the submitted file.



Fig. 6.1.16.10: Correction of Wrong File Format

The uploaded data (e.g. submitted file) can be checked and changed further here by clicking of ‘Show Checksums’ button (Fig. 6.1.16.11). Checksum is a process to verify that the submitted data has transmitted properly. The objective is to check that the file submitted to the server is exactly the same file uploaded.

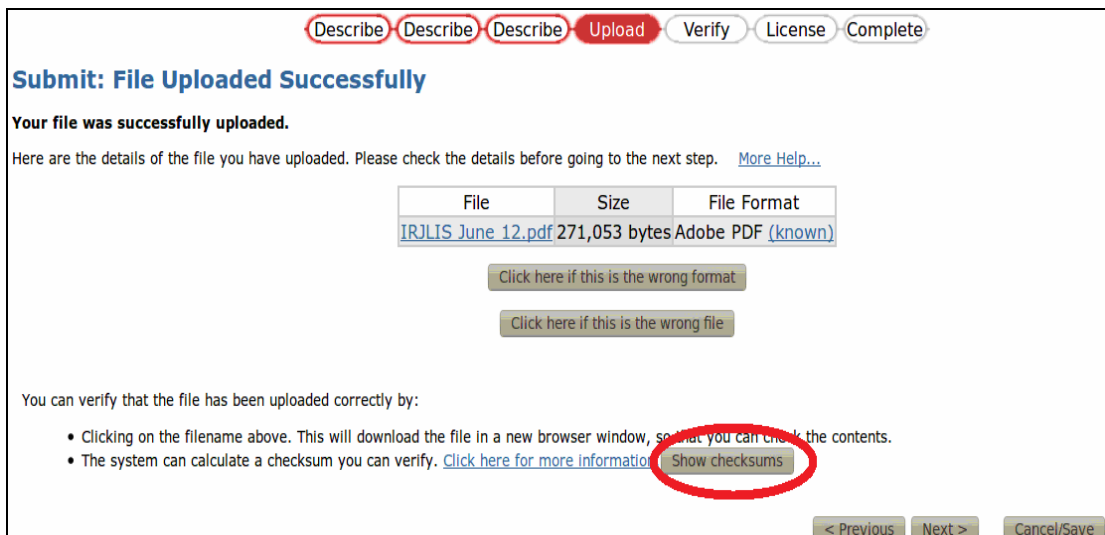


Fig. 6.1.16.11: Checksums Uploaded File

This window (Fig. 6.1.16.12) gives a chance to verify the integrity of file over time as well as when it (file) was uploaded.

Describe Describe Describe **Upload** Verify License Complete

Submit: Uploaded File

Here are the details of the file you have uploaded. Please check the details before going to the next step. [More Help...](#)

File	Size	File Format	Checksum
IRJLIS June 12.pdf	271,053 bytes	Adobe PDF (known)	9b701a88c796208b40d41f3a34ba4586 (MD5)

Click here if this is the wrong format

Click here if this is the wrong file

You can verify that the file has been uploaded correctly by:

- Clicking on the filename above. This will download the file in a new browser window, so that you can check the contents.
- Comparing the checksum displayed above with a checksum worked out on your local computer. They should be exactly the same. [Click here to find out how to do this.](#)

< Previous Next > Cancel/Save

Fig. 6.1.16.12: File Checked

Repository manager can view all metadata fields along with the file(s) and appropriate button on the right ‘*Correct one of these*’ in front of the section (Fig. 6.1.16.13) can be clicked to correct or edit information about the submitted item(s).

Learning Leads To Emancipation

Describe Describe Describe Upload Verify License Complete

Submit: Verify Submission

Not quite there yet, but nearly!

Please spend a few minutes to examine what you've just submitted below. If anything is wrong, please go back and correct it by using the buttons next to the error, or by clicking on the progress bar at the top of the page. [More Help...](#)

If everything is OK, please click the "Next" button at the bottom of the page.

You can safely check the files which have been uploaded - a new window will be opened to display them.

Item has more than one title: No

Previously published item: No Correct one of these

Item consists of more than one file: No

Authors Roy, B. K
Biswas, S. C
Mukhopadhyay, P

Title Open Access to scholarly information in India:
Trends and Developments Correct one of these

Series/Report No. None

Identifiers None

Type Article

Language English

Subject Keywords Open Access
FOSS

Abstract Focuses on the Open Access initiatives and describes some of the current open access channels and the areas where India has made significant progress. Also discusses the significance of those trends for information access in developing countries like India including problems and possible solutions. Correct one of these

Sponsors None

Description Journal Paper, Published in International Research: Journal of Library & Information Science, Vol. 2, No. 1, June. 2012.

Uploaded File: [IRJLIS June 12.pdf](#) - Adobe PDF (Known) Upload a different file

< Previous
Next >
Cancel/Save

Fig. 6.1.16.13: Submission Verification

After verification of file(s), another legal matter is granting license and finally button ‘*I grant the License*’ (Fig. 6.1.16.14) can be clicked to complete the submission process (Fig. 6.1.16.15).

Describe Describe Describe Upload Verify License Complete

There is one last step: In order for DSpace to reproduce, translate and distribute your submission worldwide, your agreement to the following terms is necessary. Please take a moment to read the terms of this license, and click on one of the buttons at the bottom of the page. By clicking on the "Grant License" button, you indicate that you grant the following terms of the license. [More Help...](#)

Not granting the license will not delete your submission. Your item will remain in your "My DSpace" page. You can then either remove the submission from the system, or agree to the license later once any queries you might have are resolved.

BURDWAN UNIVERSITY RESEARCH ARCHIVE (BURA) LICENSE FOR SUBMITTED IPR

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By signing and submitting this license, you (the author(s) or copyright owner) grants to Burdwan University Research Archive (BURA) the non-exclusive right to reproduce, translate (as defined below), and/or distribute your submission (including the abstract) worldwide in print and electronic format and in any medium, including but not limited to audio or video.

You agree that BURA may, without changing the content, translate the submission to any medium or format for the purpose of preservation.

You also agree that BURA may keep more than one copy of this submission for purposes of security, back-up and preservation.

You represent that the submission is your original work, and that you have the right to grant the rights contained in this license. You also represent that your submission does not, to the best of your knowledge, infringe upon anyone's copyright.

If the submission contains material for which you do not hold copyright, you represent that you have obtained the unrestricted permission of the copyright owner to grant BURA the rights required by this license, and that such third-party owned material is clearly identified and acknowledged within the text or content of the submission.

IF THE SUBMISSION IS BASED UPON WORK THAT HAS BEEN SPONSORED OR SUPPORTED BY AN AGENCY OR ORGANIZATION OTHER THAN BURA, YOU REPRESENT THAT YOU HAVE FULFILLED ANY RIGHT OF REVIEW OR OTHER OBLIGATIONS REQUIRED BY SUCH CONTRACT OR AGREEMENT.

BURA will clearly identify your name(s) as the author(s) or owner(s) of the submission, and will not make any alteration, other than as allowed by this license, to your submission.

BURDWAN UNIVERSITY RESEARCH ARCHIVE (BURA) LICENSE FOR SUBMITTED IPR

I Grant the License

I Do Not Grant the License

Fig. 6.1.16.14: Granting License

Describe Describe Describe Upload Verify License Complete

Submit: Submission Complete!

Your submission will now go through the workflow process designated for the collection to which you are submitting. You will receive e-mail notification as soon as your submission has become a part of the collection, or if for some reason there is a problem with your submission. You can also check on the status of your submission by going to the My DSpace page.

[Go to My DSpace](#)

[Communities and Collections](#)

Submit another item to the same collection

Fig. 6.1.16.15: Submission Completed

6.1.17. Taking Workflow Task

After submission is completed, an item enters into the BURA workflow and the relevant user/group member (e.g. E-people) involved in workflow processes will be notified through E-mail that there is a task to be taken. This section displays the task(s) in the pool waiting to be completed and concerned E-person(s) can accept the task by clicking on ‘Take Task’ button (Fig. 6.1.17).

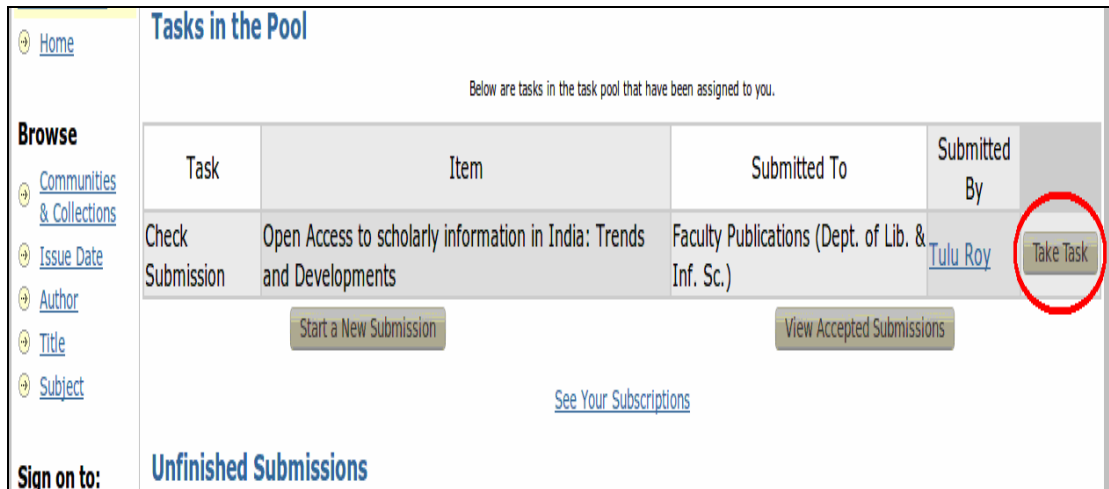


Fig. 6.1.17: Tasks in the Pool (step 1)

The next window (Fig. 6.1.17.1) displays an overview of the item in details.

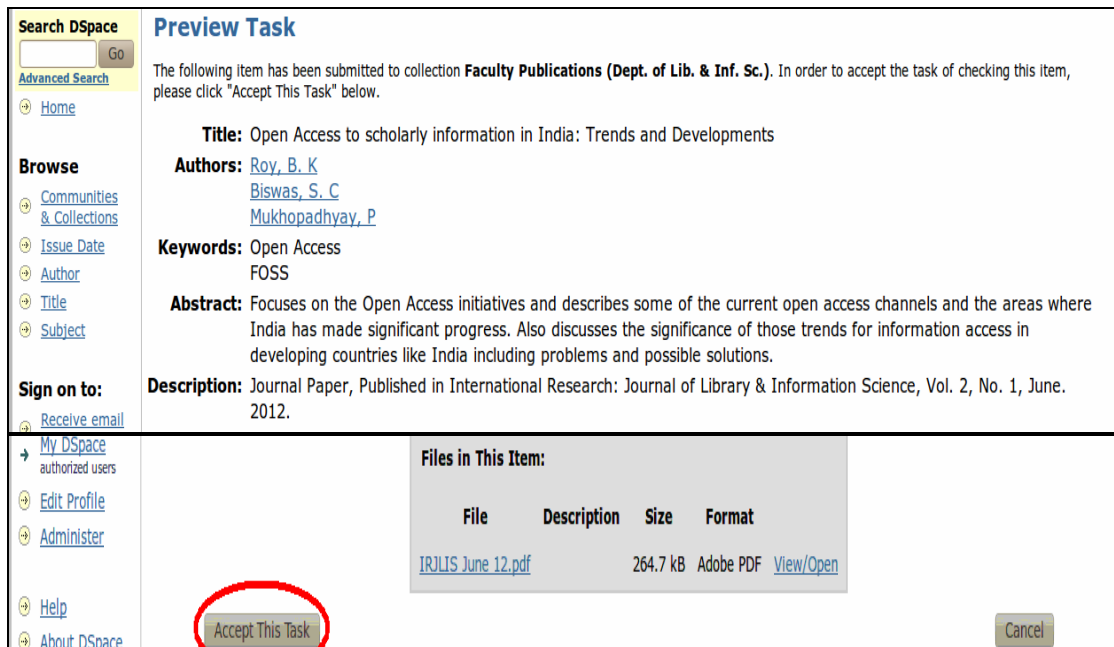


Fig. 6.1.17.1: Tasks in the Pool (step 2)

The system generates another window (Fig. 6.1.17.2) having five (5) options on the right in front of the section and concerned E-person(s) can pick up appropriate button to perform the following operations. Metadata editor can edit metadata of the items by clicking on 'Edit Metadata' button. The item can also be rejected and returned to the pool of tasks by pressing of 'Reject' button. Finally 'Approve' button can be clicked to have the item into BURA.

Search DSpace

[Advanced Search](#)
[Home](#)

Browse
[Communities & Collections](#)
[Issue Date](#)
[Author](#)
[Title](#)
[Subject](#)

Sign on to:
 [Receive email updates](#)

My DSpace
 authorized users
[Edit Profile](#)
[Administer](#)
[Help](#)
[About DSpace](#)

Perform Task

The following item has been submitted to collection **Faculty Publications (Dept. of Lib. & Inf. Sc.)**. Please review the item, check that it meets the criteria for entry into the collection. After reviewing the item, you may edit the metadata with the item, and then approve or reject the item using the controls at the bottom of the page.

Title: Open Access to scholarly information in India: Trends and Developments
Authors: [Roy, B. K](#)
[Biswas, S. C](#)
[Mukhopadhyay, P](#)
Keywords: Open Access
 FOSS
Abstract: Focuses on the Open Access initiatives and describes some of the current open access channels and the areas where India has made significant progress. Also discusses the significance of those trends for information access in developing countries like India including problems and possible solutions.
Description: Journal Paper, Published in International Research: Journal of Library & Information Science, Vol. 2, No. 1, June, 2012.

File	Description	Size	Format
IRJLIS June 12.pdf		264.7 kB	Adobe PDF View/Open

If you have reviewed the item and it is suitable for inclusion in the collection, select "Approve".

If you have reviewed the item and found it is **not** suitable for inclusion in the collection, select "Reject". You will then be asked to enter a message indicating why the item is unsuitable, and whether the submitter should change something and re-submit.

Select this option to correct, amend or otherwise edit the item's metadata.

If you wish to leave this task for now, and return to your "My DSpace", use this option.

To return the task to the pool so that another user can perform the task, use this option.

Fig. 6.1.17.2: Perform Tasks in the Pool (step 3)

The item finally gets a handle and concerned person(s) will be notified about the inclusion of the item to the repository (Fig. 6.1.17.3).

Logged in as [dspace@localhost](#) (Logout)

[BURA@University of Burdwan >](#)
[My DSpace >](#)

Search DSpace

[Advanced Search](#)
[Home](#)

Browse
[Communities & Collections](#)
[Issue Date](#)
[Author](#)
[Title](#)
[Subject](#)

Sign on to:
 [Receive email updates](#)

Thank You

The submission has been placed in the main archive. It has been assigned the following identifier:
<http://hdl.handle.net/123456789/487>

Notification has been sent to the appropriate people.

[Return to My DSpace](#)

Fig. 6.1.17.3: Submission Approval

6.1.18 Workspace Item

When the submission process is not completed (e.g. unfinished submission), the submitted item will not go to the BURA and will be displayed in the Workspace section. The process can be completed here and is shown through six screen snapshots (Fig. 6.1.18 through Fig. 6.1.18.5). The button ‘Open’ (Fig. 6.1.18) can be clicked and the subsequent window (Fig. 6.1.18.1) having three options will be displayed and any one of them can be picked up.

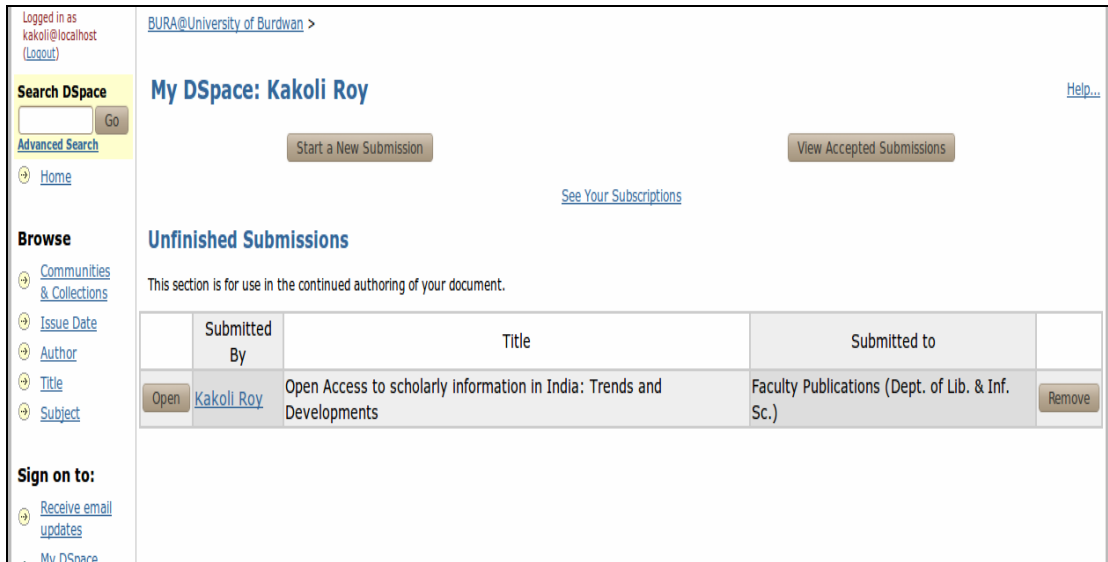


Fig. 6.1.18: Workspace Item

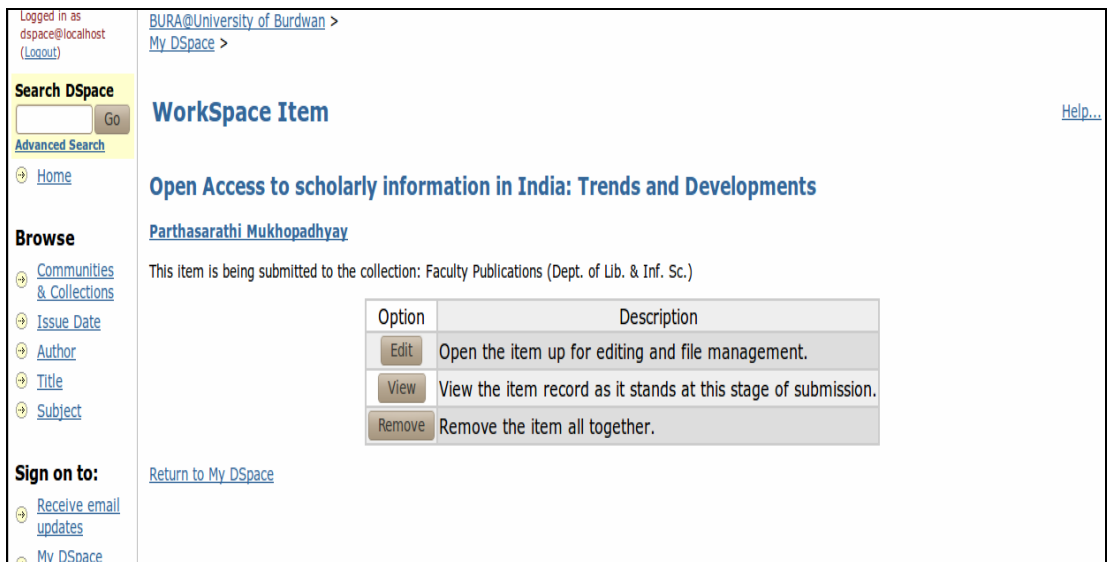


Fig. 6.1.18.1: Description of Workspace Item

In anytime, edition, deletion, withdrawn and removal of item is possible and can be done through the librarian interface (Fig. 6.1.18.2). This window displays the items in details and necessary changes in metadata fields along with the file can be made here by clicking on the corresponding button on the right 'Remove' in front of the section. Item can also be viewed in the same fashion as it would be displayed when it is finally submitted to the BURA.

- [Groups](#)
- [Items](#)
- [Metadata Registry](#)
- [Bitstream Format Registry](#)
- [Workflow](#)
- [Authorization](#)
- [Edit News](#)
- [Edit Default License](#)
- [Supervisors](#)
- [Statistics](#)
- [Import metadata](#)
- [Withdrawn Items](#)
- [Help](#)
- [Log Out](#)

Edit Item

PLEASE NOTE: These changes are not validated in any way. You are responsible for entering the data in the correct format. If you are not sure what the format is, please do NOT make changes.

[More Help...](#)

Item internal ID: 277

Handle: 123456789/487

Last modified: 2-Apr-2013 09:30:31

In Collections: Faculty Publications (Dept. of Lib. & Inf. Sc.)

Item page: <http://localhost:8080/xmlui/handle/123456789/487>

Item's Authorizations: [Edit](#)

[Withdraw...](#)
[Delete \(Expunge\)...](#)
[Move Item](#)

Schema	Element	Qualifier	Value	Language	
dc	contributor	author	Roy, B. K	<input type="text"/>	Remove
dc	contributor	author	Biswas, S. C	<input type="text"/>	Remove
			Mukhopadhyay, P	<input type="text"/>	

Bitstreams

Note that if the "user format description" field isn't empty, the format will always be set to "Unknown", so clear the user format description before changing the format field.

Primary Bitstream	Name	Source	Description	Format	User Format Description	
<input type="radio"/>	roy-mukhopadhyay-biswas.p	/dspace/upload/roy-mukhopa	<input type="text"/>	4 (Adobe PDF)	<input type="text"/>	View Remove
<input type="radio"/>	license.txt	Written by org.dspace.conter	<input type="text"/>	2 (License)	<input type="text"/>	View Remove

[Add Bitstream](#)

[Update](#)
[Cancel](#)

Fig. 6.1.18.2: Workspace Item: Edition

Finally ‘*Show full item record*’ button (Fig. 6.1.18.3) can be clicked to show the metadata records of the submitted item (Fig. 6.1.18.4).

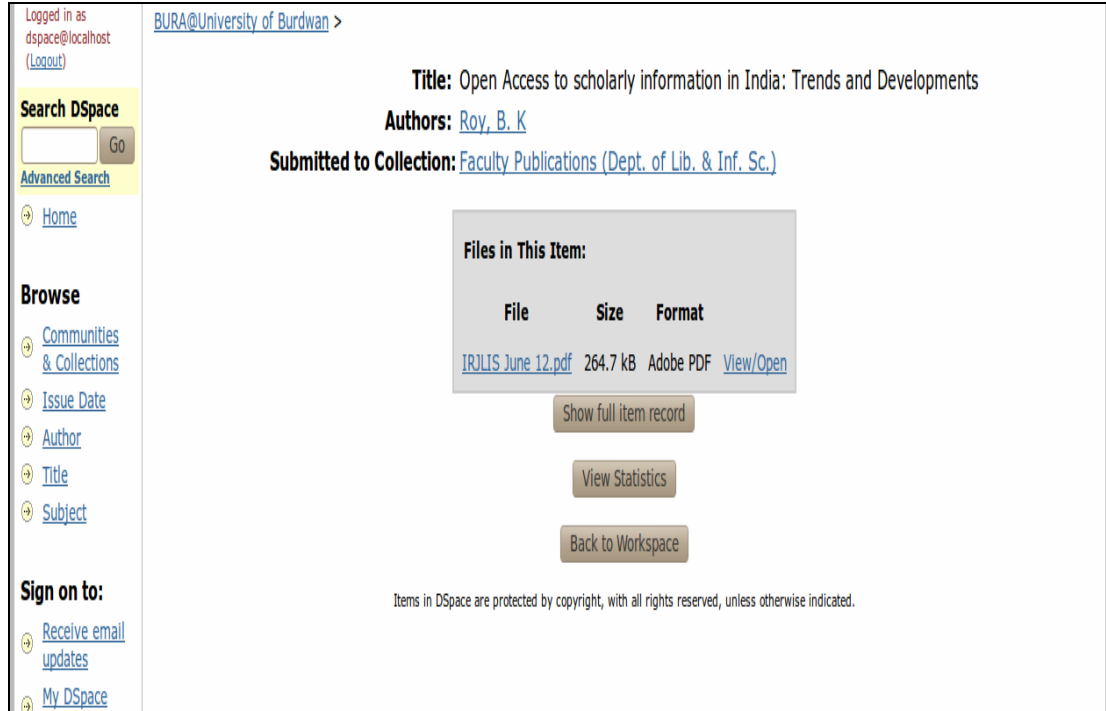


Fig. 6.1.18.3: View Workspace Item

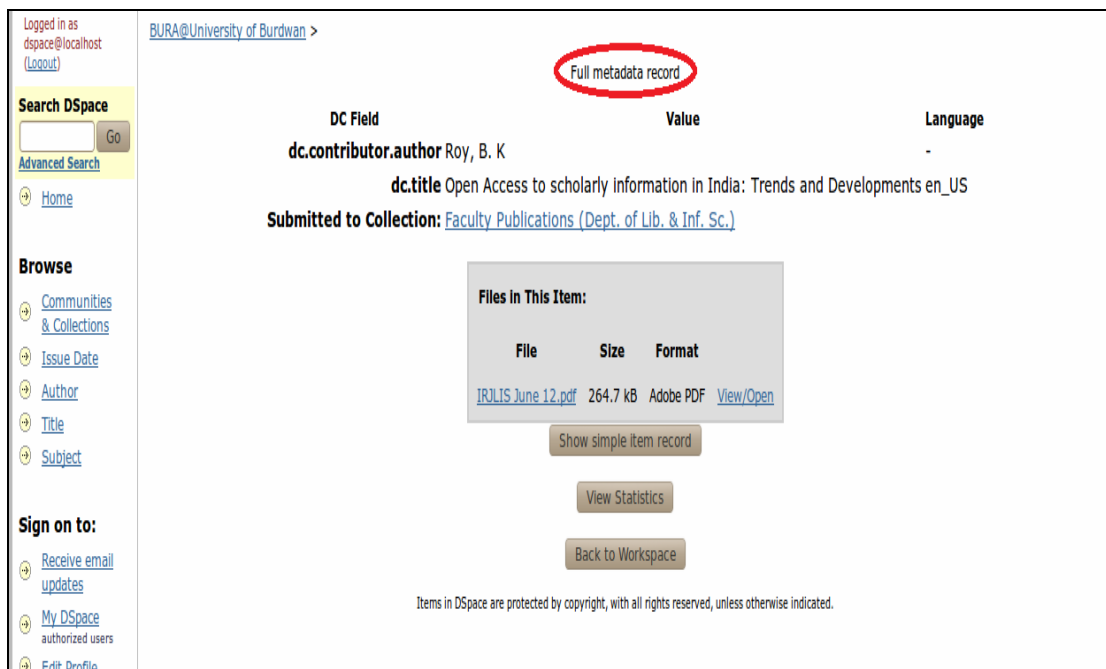


Fig. 6.1.18.4: Short displays of full Metadata record of Workspace Item

The item can also be removed (vide section 4.2.1.16 & 4.2.1.16.1 of chapter 4) from the archive after clicking of ‘*Remove the item*’ button (Fig. 6.1.18.5).

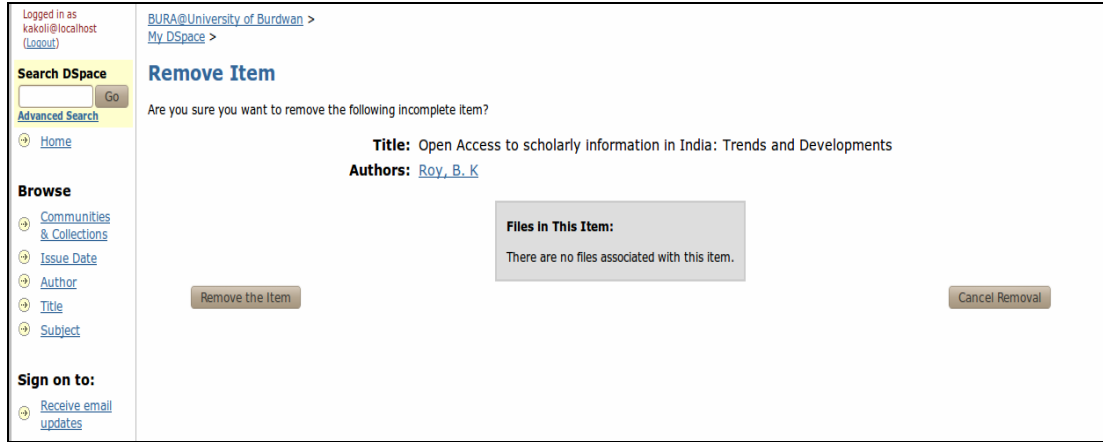


Fig. 6.1.18.5: Item Removed

6.1.19. Withdrawal item

Repository must facilitate processes that supports withdrawn of submitted item from the system. In section 4.2.1.16 & 4.2.1.16.1 of chapter 4, this study recommends that submitted item(s) may be withdrawn from the archive on special circumstances. The moment administrator clicks on ‘*Withdraw*’ button (Fig. 6.1.18.2), the corresponding window (Fig. 6.1.19) automatically withdraws the item from the repository after clicking on ‘*Withdraw*’ button.

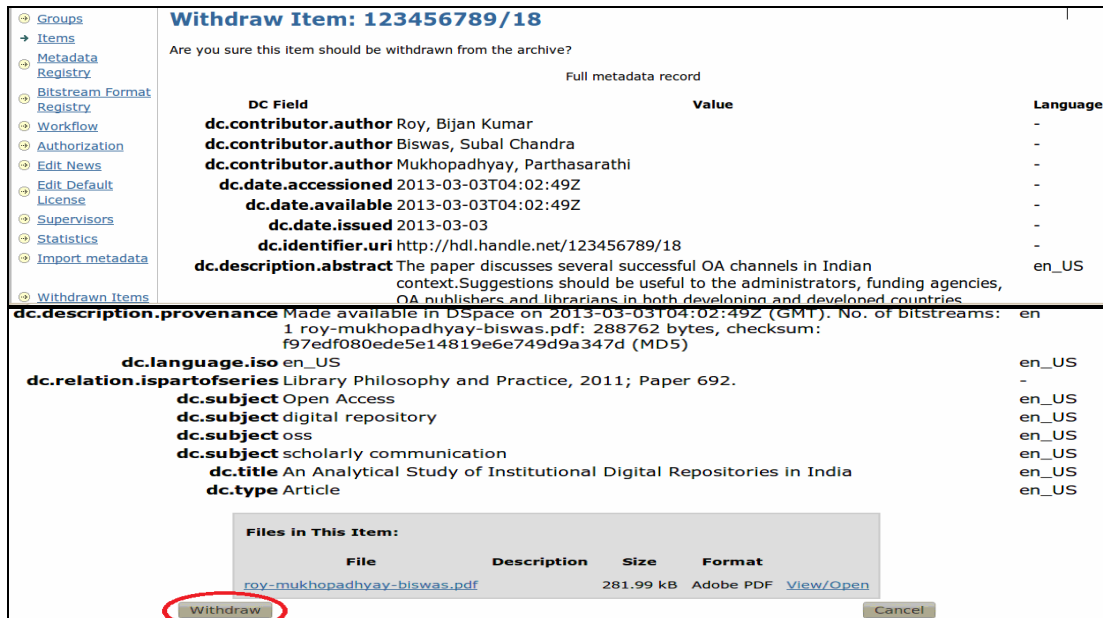


Fig. 6.1.19: Withdrawal of Items

6.1.20. Move Item

In any repository system, there should have a mechanism by which item can be moved from one Collection to another. BURA allows item to be moved from one Collection to another if it is entered wrongly to a Collection and can be done by pressing of ‘Move Item’ button (Fig. 6.1.18.2). The window (Fig. 6.1.20) is supported by drop-down menu option and displays all the Collections available in the system. Repository manager can pick up appropriate Collection where item can be moved.

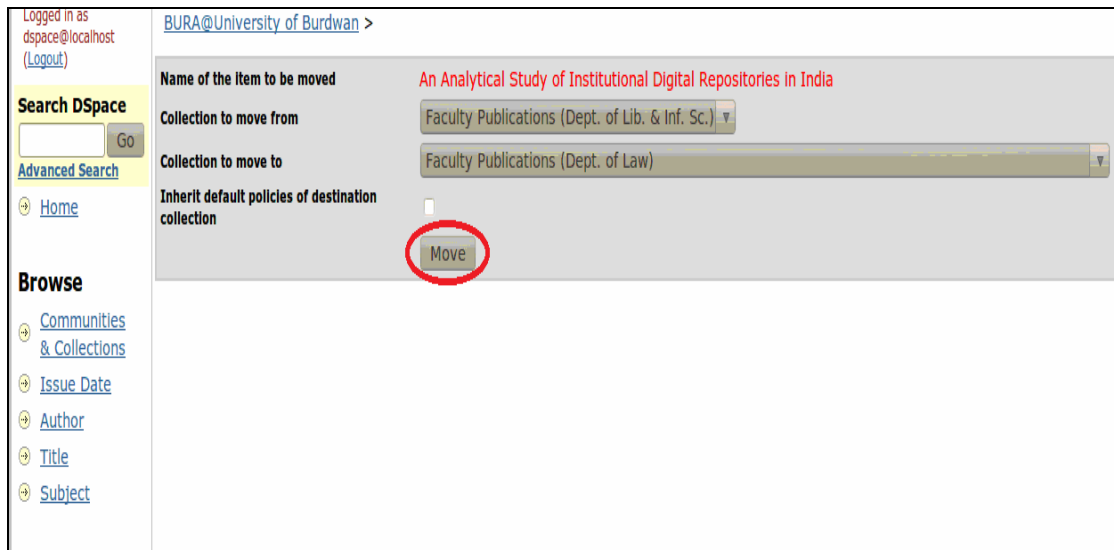


Fig. 6.1.20: Collection selection to move Workspace Item

A click on ‘Move’ button finally displays another window (Fig. 6.1.20.1) and button ‘Remove the Item’ can be clicked to move the item to the desired location.

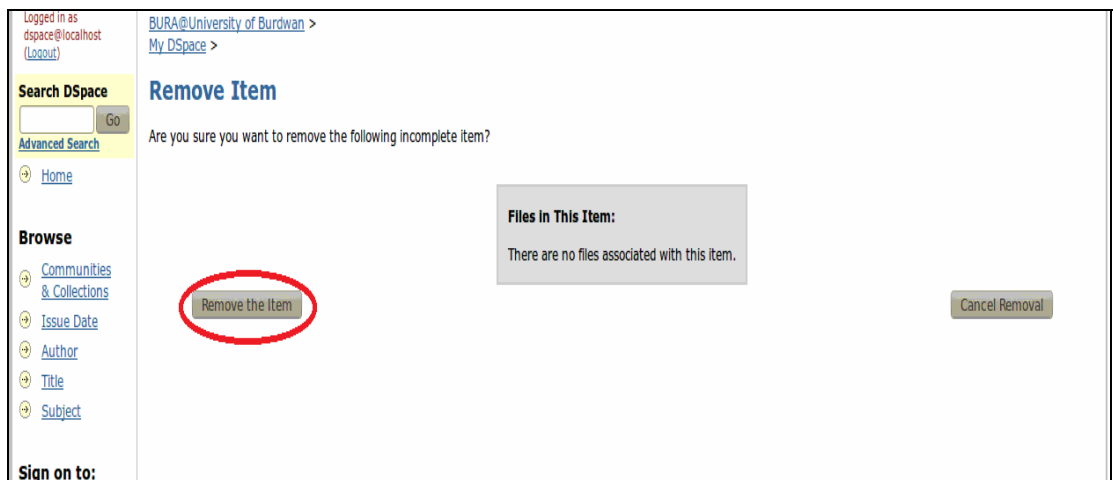


Fig. 6.1.20.1: Workspace Item Moved

6.2 Services of BURA

Only a few repositories throughout the world have implemented service model and have others in the pipeline. Evidence suggests that it is repository services that will determine the uptake and success of repositories within the academic and research community. A close study of the most prominent OARs registered in ROAR and OpenDOAR databases along with some other best practice guidelines as proposed by SPARC, CARL reveals that following core services should form an integral part of a typical OARs. There are already many examples of repository services in existence. BURA offers some basic functionality e.g. basic and advanced search facilities, different browsing options, downloading etc. The following are the core services BURA offers to its users discussed below with screen snapshots.

6.2.1 Browsing of Resources

Browsing allows user to go through a list of works in a variety of specified orders. The browsing panel, as designed in BURA, contains all the Communities, Sub-communities and networked resources placed under them. The browsing panel of user interface is primarily meant for linking globally available and locally useful OAR resources with software framework of BURA. Here user can browse documents by

- Community and Collection;
- By Title;
- By Subject;
- By Author;
- By Date, and
- By Departments.

BURA allows user to browse a list of works in a variety of specified orders mentioned below. Any item or record that is processed and stored in IDR Cluster of the software framework can be linked with browsing panel of BURA user interface. The following screen snapshots (Fig. 6.2.1 through Fig. 6.2.1.6) display and show browsing documents through different search syntaxes.

A. Browse by Community and Collection

This option takes user through the Communities arranged in alphabetical order and allows them to see the Sub-communities and Collections within each Community. And user can search documents through all Communities/Collections in the system (Fig. 6.2.1). Additionally, the browse can be limited to items within a particular Community or Collection (Fig. 6.2.1.1).

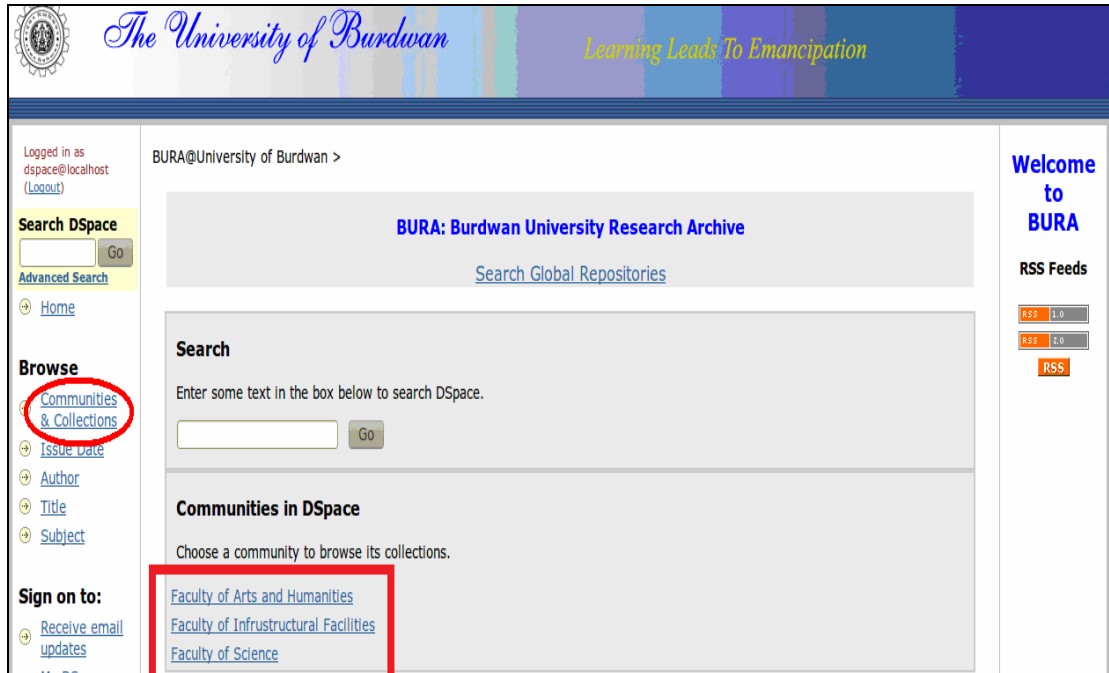


Fig. 6.2.1: Browse by Communities



Fig. 6.2.1.1: Browse by Collections

B. Browse by Title

This option allows user to search documents through title of the documents. All the titles of items are arranged in alphabetical order in BURA (Fig. 6.2.1.2).

Logged in as dspace@localhost (Logout) BURA@University of Burdwan >

Browsing by Title

Search DSpace: Go! Advanced Search

Home

Browse

- Communities & Collections
- Issue Date
- Author
- Title**
- Subject

Sign on to:

- Receive email updates
- My DSpace

Jump to: 0-9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

or enter first few letters: Go!

Sort by: title In order: Ascending Results/Page: 20 Authors/Record: All Update Export metadata

Showing results 1 to 20 of 249 [next >](#)

Issue Date	Title	Author(s)
13-Mar-2013	9 A Case Sttudy:: Server Performance Measurementt ffor E--Learniiing Systeem iin Campus Enviirnnementt	Ismaili, Mohd Nazrii
9-Mar-2013	Achievement of Department of Chemistry in the International Year of Chemistry The	Department of Chemistry, Jadavpur University
13-Mar-2013	Advertisement for the temporary position : U.G.C. Project	DEPARTMENT OF BUSINESS ADMINISTRATION UNIVERSITY OF LUCKNOW
14-Mar-2013	AGRI-ENVIRONMENTAL SCIENCE	Department of Forest and Environmental Science and Technology

Fig. 6.2.1.2: Browse by Title

C. Browse by Author

This option allows user to move through an alphabetical list of all authors of items in BURA (Fig. 6.2.1.3).

Logged in as dspace@localhost (Logout) BURA@University of Burdwan >

Browsing by Author

Search DSpace: Go! Advanced Search

Home

Browse

- Communities & Collections
- Issue Date
- Author**
- Title
- Subject

Sign on to:

- Receive email updates
- My DSpace

Jump to: 0-9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

or enter first few letters: Go!

Order: Ascending Results/Page: 20 Update

Showing results 1 to 20 of 173 [next >](#)

Acharya, Somen
Agrawal, Rajesh
Al-Shimmary, Mushtaq A. H.
Ameer, Mohammed Abdul
Amin, Saiful
Arriaga, Ismael Rosas
Bagchi, Pradipta
Baij, Kalika

Fig. 6.2.1.3: Browse by Author

D. Browse by Date

This option allows user to move through a list of all items in BURA in reverse chronological order by publication date (if previously published or date of creation). But it can be changed by clicking on the ‘*Show Older First*’ link on the top right of the page (Fig. 6.2.1.4).

The screenshot shows the BURA interface with the following elements:

- Left Sidebar:**
 - Search DSpace: [Input field] [Go]
 - Advanced Search
 - Home
 - Browse:**
 - Communities & Collections
 - Issue Date** (circled in red)
 - Author
 - Title
 - Subject
 - Sign on to:
 - Receive email updates
 - My DSpace
- Main Content Area:**
 - Logged in as dspace@localhost (Logout)
 - BURA@University of Burdwan >
 - Browsing by Issue Date**
 - Jump to a point in the index: (Choose year) (Choose month) [Go]
 - Or type in a year: [Input field]
 - Sort by: issue date In order: Ascending Results/Page 20 Authors/Record: All [Update] [Export metadata]
 - Showing results 1 to 20 of 249
 - next >
 - Table:**

Issue Date	Title	Author(s)
3-Mar-2013	Designing single-window search service for electronic theses and dissertations through metadata harvesting	Sarkar, Prasenjit; Mukhopadhyay, Parthasarathi
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Draft Syllabus for M. Phil in Library and Information Science	Department of Library and Information Science
3-Mar-2013	Open Source Software for Libraries: A Trend Report	Amin, Saiful
3-Mar-2013	An Analytical Study of Institutional Digital Repositories in India	Roy, Bijan Kumar; Biswas, Subal Chandra;

Fig. 6.2.1.4: Browse by Date

E. Browse by Subject

This option allows user to move through subject indices/tags assigned to works arranged in alphabetical order (Fig. 6.2.1.5).

The screenshot shows the BURA interface with the following elements:

- Left Sidebar:**
 - Search DSpace: [Input field] [Go]
 - Advanced Search
 - Home
 - Browse:**
 - Communities & Collections
 - Issue Date
 - Author
 - Title
 - Subject** (circled in red)
 - Sign on to:
 - Receive email updates
 - My DSpace
- Main Content Area:**
 - Logged in as dspace@localhost (Logout)
 - BURA@University of Burdwan >
 - Browsing by Subject**
 - Jump to: 0-9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
 - or enter first few letters: [Input field] [Go]
 - Order: Ascending Results/Page 20 [Update]
 - Showing results 1 to 20 of 190
 - next >
 - Subject List:**
 - [administration](#)
 - [Advertisement](#)
 - [Agro-Tourism](#)
 - [American Culture](#)
 - [Application Form](#)
 - [article](#)
 - [ARTIFICIAL INTELLIGENCE](#)
 - [arts](#)

Fig. 6.2.1.5: Browse by Subject

F. Browse by Department

This option allows user to move through an alphabetical list of academic departments and research units on campus assigned to works in the repository (Fig. 6.2.1.6).



Fig. 6.2.1.6: Browse by Departments

6.2.2 Searching in BURA

Search is an essential component of discovery in BURA provides a search interface and supports as many search features as possible. Search facility of BURA User Interface is provided through IDR Cluster of the software framework. It produces a simple but powerful search interface along with a few additional utilities like facility to display recent submissions. The end user can browse, search and access the collections using the hierarchies and also the alphabetic bar menu. BURA supports sophisticated searching with the help of search operators (Boolean, positional and relational operators) both within the local repository and across the repositories of multiple institutions. BURA offers by default the following search features: (1) Search all DSpace, (2) Bounded Search within a specified Community's Collection, (3) Simple search and (4) Advanced search. Even users can restrict search to a specific subject category (vide section 6.5).

A. Searching Community/Collection

BURA also allows user to search documents through all Communities/Collections in the system (Fig. 6.2.2. & Fig. 6.2.2.1). User can also limit search to a specific Community or Collection, navigate to that Community or Collection and use the search bar on that page (Fig. 6.2.2.2 & Fig. 6.2.2.3).

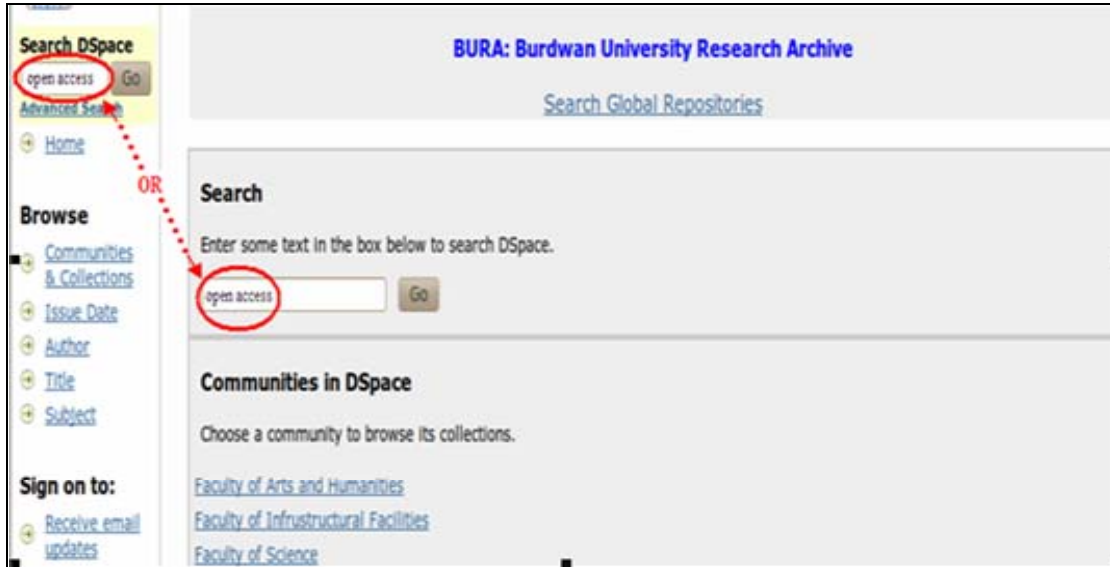


Fig. 6.2.2: Search in all DSpace

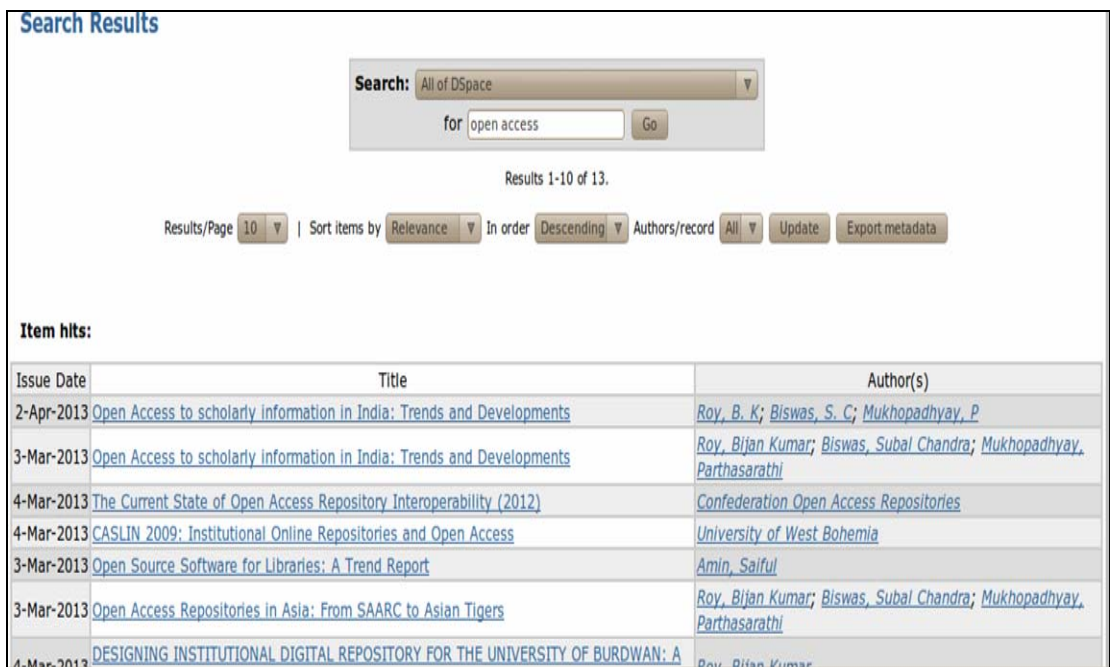


Fig. 6.2.2.1: Search results in all DSpace

Search Results

Search: Faculty of Arts and Humanities
 for repository Go

Results 1-7 of 7.

Results/Page 10 | Sort items by Relevance In order Descending Authors/record All Update

Item hits:

Issue Date	Title	Author(s)
4-Mar-2013	The Current State of Open Access Repository Interoperability (2012)	Confederation Open Access Repositories
4-Mar-2013	DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE	Roy, Bijan Kumar
4-Mar-2013	Pathfinder Research on Web-based Repositories: FINAL REPORT	Ware, Mark
4-Mar-2013	CASLIN 2009: Institutional Online Repositories and Open Access	University of West Bohemia
3-Mar-2013	An Analytical Study of Institutional Digital Repositories in India	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi

Fig. 6.2.2.2: Search a specific Community

Search Results

Search: Faculty Publications (Dept. of Lib. & Inf. Sc.)
 for open access Go

Results 1-5 of 5.

Results/Page 10 | Sort items by Relevance In order Descending Authors/record All Update

Item hits:

Issue Date	Title	Author(s)
2-Apr-2013	Open Access to scholarly information in India: Trends and Developments	Roy, B. K; Biswas, S. C; Mukhopadhyay, P
3-Mar-2013	Open Access to scholarly information in India: Trends and Developments	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Designing single-window search service for electronic theses and dissertations through metadata harvesting	Sarkar, Prasenjit; Mukhopadhyay, Parthasarathi
3-Mar-2013	An Analytical Study of Institutional Digital Repositories in India	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi

Fig. 6.2.2.3: Search a specific Collection

B. Advanced Search

To navigate to the advanced search page, user can click on ‘Advanced Search’ link (Fig. 6.2.2) at the top left corner of the BURA software framework. This interface (Fig. 6.2.2.4) allows user to specify the search fields and user can combine these searches with the Boolean operators "AND", "OR" or "NOT". The window is supported by drop down menu list from where user can pick up required value and can restrict search to a Community by clicking on the arrow to the right of the top box. If users like to search all of the BURA, user can leave that box in the default position. User can select the field to be searched in the left hand column and on the other hand search word or phrase can be used in the right hand column. User can select the Boolean operator to combine searches by clicking on the arrow to the right of the "AND" box. The window (Fig. 6.2.2.5) display the results against a search query matched (e.g. *author:bijan* or *author:biswas* or *author:mukhopadhyay*).

Fig. 6.2.2.4: Advanced Search Syntax

Search Results

Search: All of DSpace
for ((author:roy) OR (author:biw Go

Results 1-6 of 6.

Results/Page 10 | Sort items by Relevance In order Descending Authors/record All Update

Item hits:

Issue Date	Title	Author(s)
3-Mar-2013	Open Access to scholarly information in India: Trends and Developments	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	An Analytical Study of Institutional Digital Repositories in India	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
2-Apr-2013	Open Access to scholarly information in India: Trends and Developments	Roy, B. K; Biswas, S. C; Mukhopadhyay, P
4-Mar-2013	DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE	Roy, Bijan Kumar
3-Mar-2013	Designing single-window search service for electronic theses and dissertations through metadata harvesting	Sarkar, Prasenjit; Mukhopadhyay, Parthasarathi

Fig. 6.2.2.5: Display of Results (Advanced Search)

C. Exact Term/Phrase Search

The search term can be a word or a phrase. One can use a search word, e.g. “open access” or a phrase “open access repository”. For phrase search, the phrase should be enclosed with double quotes.

The screenshot shows a search interface with a search box containing "open access" and a "Go" button. A red box highlights the text "Exact Term/Phrase Search". Below the search box, it says "Results 1-10 of 10." and "Results/Page 10 | Sort items by Relevance | In order Descending | Authors/record All | Update | Export metadata".

Item hits:

Issue Date	Title	Author(s)
2-Apr-2013	Open Access to scholarly information in India: Trends and Developments	Roy, B. K; Biswas, S. C; Mukhopadhyay, P
3-Mar-2013	Open Access to scholarly information in India: Trends and Developments	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
4-Mar-2013	The Current State of Open Access Repository Interoperability (2012)	Confederation Open Access Repositories
4-Mar-2013	CASLIN 2009: Institutional Online Repositories and Open Access	University of West Bohemia
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
4-Mar-2013	DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE	Roy, Bijan Kumar

Fig. 6.2.2.6: Exact Term/Phrase Search

D. Exact Word Match Search

Put a plus (+) sign before a word if it MUST appear in the search result. For instance, in the following search the word "archive" is optional, but the word "digital" must be in the result (e.g. *+digital archive*).

The screenshot shows a search interface with a search box containing "+digital archive" and a "Go" button. Below the search box, it says "Results 1-10 of 12." and "Results/Page 10 | Sort items by Relevance | In order Descending | Authors/record All | Update | Export metadata".

Item hits:

Issue Date	Title	Author(s)
3-Mar-2013	Designing single-window search service for electronic theses and dissertations through metadata harvesting	Sarkar, Prasenjit; Mukhopadhyay, Parthasarathi
5-Mar-2013	DIGITAL LIBRARY ENVIRONMENT - I	Department of Library and Information Science, Jadavpur University
5-Mar-2013	DIGITAL LIBRARY CREATION AND USE - I	Department of Library and Information Science, Jadavpur University
4-Mar-2013	DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE	Roy, Bijan Kumar
5-Mar-2013	Digital Library Creation and Management	Department of Library and Information Science, Jadavpur University
3-Mar-2013	An Analytical Study of Institutional Digital Repositories in India	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
4-Mar-2013	Pathfinder Research on Web-based Repositories: FINAL REPORT	Ware, Mark
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
4-Mar-2013	CASLIN 2009: Institutional Online Repositories and Open Access	University of West Bohemia
3-Mar-2013	Open Source Software for Libraries: A Trend Report	Amin, Saiful

Fig. 6.2.2.7: Exact Word Match Search

E. Eliminate Works with unwanted Words

Put a minus (-) sign before a word if it should not appear in the search results. Alternatively, you can use NOT. This can limit your search to eliminate unwanted hits. For instance, in the searches e.g. *digital – archive* means *digital NOT archive*

Issue Date	Title	Author(s)
5-Mar-2013	DIGITAL LIBRARY ENVIRONMENT – I	Department of Library and Information Science, Jadavpur University
5-Mar-2013	DIGITAL LIBRARY CREATION AND USE – I	Department of Library and Information Science, Jadavpur University
4-Mar-2013	DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE	Roy, Bijan Kumar
5-Mar-2013	Digital Library Creation and Management	Department of Library and Information Science, Jadavpur University
3-Mar-2013	An Analytical Study of Institutional Digital Repositories in India	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
4-Mar-2013	Pathfinder Research on Web-based Repositories: FINAL REPORT	Ware, Mark
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
4-Mar-2013	CASLIN 2009: Institutional Online Repositories and Open Access	University of West Bohemia
3-Mar-2013	Open Source Software for Libraries: A Trend Report	Amin, Saiful
4-Mar-2013	The Current State of Open Access Repository Interoperability (2012)	Confederation Open Access Repositories

Fig. 6.2.2.8: Eliminate Works with unwanted Words

F. Fielded Search

The Fielded Search query enables searching of specific field provided in the query. One can search for a term in a particular field or any field by typing the field name followed by a colon ":" and then the term looking for.

e.g.: *author:bjian* or *title:repository*

Issue Date	Title	Author(s)
4-Mar-2013	DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE	Roy, Bijan Kumar
3-Mar-2013	Open Access to scholarly information in India: Trends and Developments	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	An Analytical Study of Institutional Digital Repositories in India	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi

Fig. 6.2.2.9: Fielded Search by Author

Search Results

Fielded Search by Title

Search: All of DSpace
for title:repository Go

Results 1-6 of 6.

Results/Page 10 | Sort items by Relevance In order Descending Authors/record All Update Export metadata

Item hits:

Issue Date	Title	Author(s)
4-Mar-2013	The Current State of Open Access Repository Interoperability (2012)	Confederation Open Access Repositories
4-Mar-2013	CASLIN 2009: Institutional Online Repositories and Open Access	University of West Bohemia
4-Mar-2013	Pathfinder Research on Web-based Repositories: FINAL REPORT	Ware, Mark
3-Mar-2013	An Analytical Study of Institutional Digital Repositories in India	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
4-Mar-2013	DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE	Roy, Bijan Kumar
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi

Fig. 6.2.2.10: Fielded Search by Title

G. Wild cards

The symbol ‘*’ is used for multiple characters matching, as in “arch*” matches with archive, archival, archiving etc. It is (*) used as an asterisk after a word stem to get all hits having words starting with that root.

Search Results

Search: All of DSpace
for ((arch*)) Go

Results 1-3 of 3.

Results/Page 10 | Sort items by Relevance In order Descending Authors/record All Update

Item hits:

Issue Date	Title	Author(s)
3-Mar-2013	Open Access to scholarly information in India: Trends and Developments	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Designing single-window search service for electronic theses and dissertations through metadata harvesting	Sarkar, Prasenjit; Mukhopadhyay, Parthasarathi
17-Mar-2013	Fuzzy Voice Coding with Significant Impulses Modeling and Redundant Waveform Recycling	Arriaga, Ismael Rosas

Fig. 6.2.2.11: Search by Wild cards (*)

The symbol ‘?’ is used for a single character, as in ‘op?n’ that matches words like ‘open’, ‘open access’ etc.

Search Results

Search: All of DSpace
for ((op?n)) Go

Results 1-10 of 12.

Results/Page 10 | Sort items by Relevance In order Descending Authors/record All Update

Item hits:

Issue Date	Title	Author(s)
3-Mar-2013	Open Access to scholarly information in India: Trends and Developments	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Open Source Software for Libraries: A Trend Report	Amin, Saiful
4-Mar-2013	The Current State of Open Access Repository Interoperability (2012)	Confederation Open Access Repositories
4-Mar-2013	CASLIN 2009: Institutional Online Repositories and Open Access	University of West Bohemia
4-Mar-2013	DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE	Roy, Bijan Kumar
4-Mar-2013	Pathfinder Research on Web-based Repositories: FINAL REPORT	Ware, Mark
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Designing single-window search service for electronic theses and dissertations through metadata harvesting	Sarkar, Prasenjit; Mukhopadhyay, Parthasarathi

Fig. 6.2.2.12: Search by Wild cards (?)

H. Fuzzy Search

One of the popular fuzzy search algorithms is Levenshtein distance or Edit Distance, algorithm named after the Russian scientist Vladimir Levenshtein, who devised the algorithm in 1965. The Levenshtein distance algorithm has been used in:

- Spell checking
- DNA analysis
- Speech recognition
- Plagiarism detection

To do a fuzzy search, use the tilde symbol, "~", at the end of a single-word term. To search for a term similar in spelling to "subal" use the fuzzy search: *subol~*
This search will find terms like subal. For example: *author:subol~* can match subal

Search Results

Fuzzy Search

Search: All of DSpace
for author:subol~ Go

Results 1-4 of 4.

Results/Page 10 | Sort items by Relevance In order Descending Authors/record All Update Export metadata

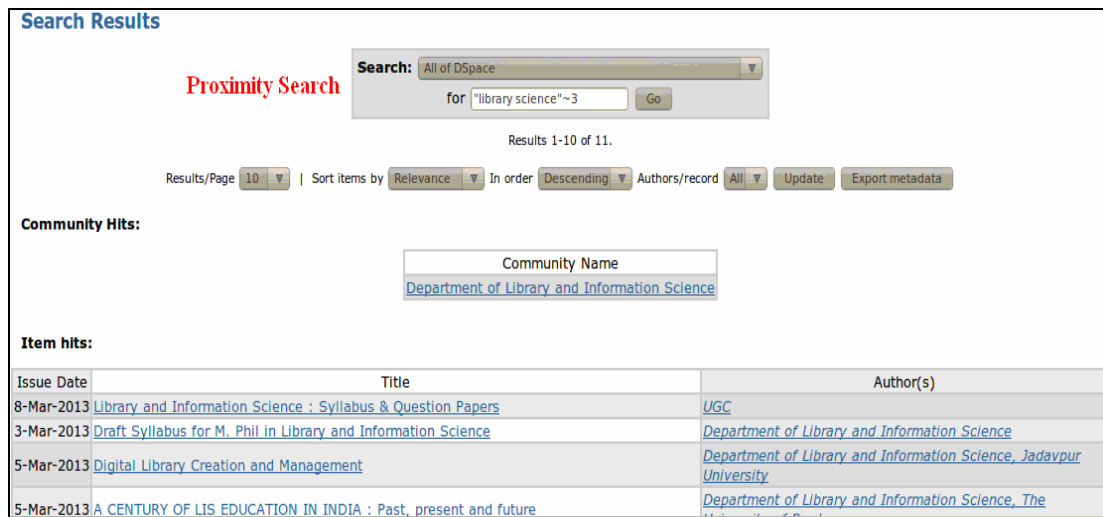
Item hits:

Issue Date	Title	Author(s)
3-Mar-2013	Open Access to scholarly information in India: Trends and Developments	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	An Analytical Study of Institutional Digital Repositories in India	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
13-Mar-2013	THE MODERATING ROLE OF INDUSTRIAL EXPERIENCE IN THE JOB SATISFACTION, INTENTION TO LEAVE RELATIONSHIP: AN EMPIRICAL STUDY AMONG SALESMEN IN INDIA	Purani, Keyoor; Sahadev, Sunil

Fig. 6.2.2.13: Fuzzy Search

I. Proximity Search

Proximity search is used in a query to retrieve documents that have two words or phrases in proximity i.e. that they appear near to each other. To do a proximity search, use the tilde symbol, "~", at the end of a phrase. For example, “*library science*”~3. It will retrieve records where the words ‘library’ and ‘science’ are within the three words distance.



Search Results

Proximity Search

Search: All of DSpace
for "library science"~3 Go

Results 1-10 of 11.

Results/Page 10 | Sort items by Relevance In order Descending Authors/record All Update Export metadata

Community Hits:

Community Name
[Department of Library and Information Science](#)

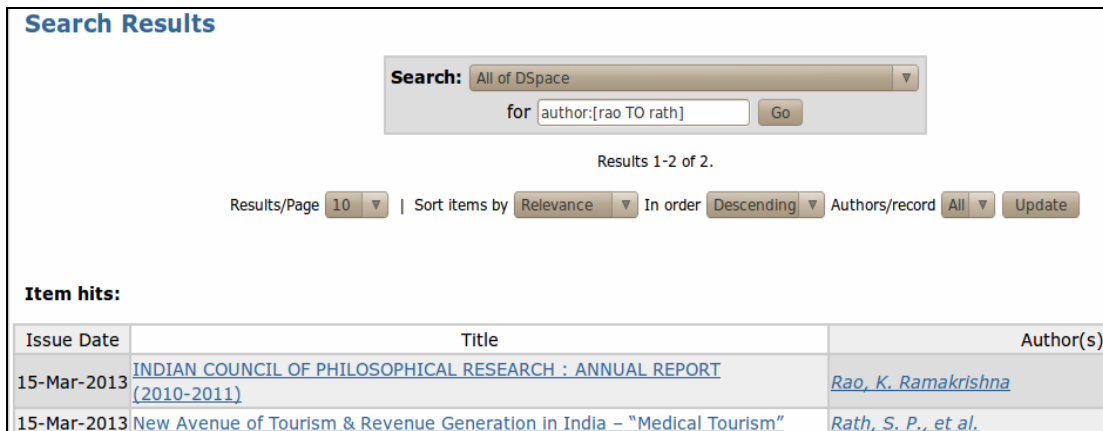
Item hits:

Issue Date	Title	Author(s)
8-Mar-2013	Library and Information Science : Syllabus & Question Papers	UGC
3-Mar-2013	Draft Syllabus for M. Phil in Library and Information Science	Department of Library and Information Science
5-Mar-2013	Digital Library Creation and Management	Department of Library and Information Science, Jadavpur University
5-Mar-2013	A CENTURY OF LIS EDUCATION IN INDIA : Past, present and future	Department of Library and Information Science, The

Fig. 6.2.2.14: Proximity Search

J. Range search

Range Queries allow one to match documents whose field(s) values are between the lower and upper bound specified by the Range Query. Range Queries can be inclusive or exclusive of the upper and lower bounds. Sorting is done lexicographically. If the search query is- *author:[rao TO rath]*. Then the system retrieves documents authored by names that fall between ‘rao’ and ‘rath’ (Fig. 6.2.2.15).



Search Results

Search: All of DSpace
for author:[rao TO rath] Go

Results 1-2 of 2.

Results/Page 10 | Sort items by Relevance In order Descending Authors/record All Update

Item hits:

Issue Date	Title	Author(s)
15-Mar-2013	INDIAN COUNCIL OF PHILOSOPHICAL RESEARCH : ANNUAL REPORT (2010-2011)	Rao, K. Ramakrishna
15-Mar-2013	New Avenue of Tourism & Revenue Generation in India – "Medical Tourism"	Rath, S. P., et al.

Fig. 6.2.2.15: Range Search by Author

Whereas, the query is - *author:{agrawal TO bali}* excludes ‘agrawal’ and ‘bali’ (Fig. 6.2.2.16).

Search Results

Search: All of DSpace
for *author:{agrawal TO bali}* Go

Results 1-10 of 26.

Results/Page 10 | Sort Items by Relevance In order Descending Authors/record All Update

Item hits:

Issue Date	Title	Author(s)
3-Mar-2013	Open Source Software for Libraries: A Trend Report	Amin, Saiful
6-Mar-2013	Inbreeding depression in red deer calves	Walling, C A., et al
6-Mar-2013	The Bodily Incorporation of Mechanical Devices: Ethical and Religious Issues (Part I)	Campbell, C.S, et al.
6-Mar-2013	An Urban Parameterization for a Global Climate Model. Part I: Formulation and Evaluation for Two Cities	OLESON, K W, et al.
7-Mar-2013	Spatial distribution of the risk of dengue fever in southeast Brazil, 2006-2007	Cordeiro, R, et al.
7-Mar-2013	Mathematics funds of knowledge : sotmaute and sermaute fish in a Torres Strait Islander community.	Ewing, B.F

Fig. 6.2.2.16: Range Search by Author

K. Boolean Search

Boolean ‘AND’, ‘OR’, ‘NOT’ are used for Boolean combinations. Boolean operators must be CAPITALIZED. Boolean operators allow terms to be combined through logic operators.

- ‘OR’ is the default conjunction operator. One can use ‘|’ instead of ‘OR’. It is used to enlarge searches to find works containing any of the words or phrases surrounding this operator. To search for documents that contain either the word "repository" or "archive" use the query: "repository" OR "archive". It will retrieve all works that contain either the words "repository" or "archive".

Search Results

Search: All of DSpace
for *"repository" OR "archive"* Go

Results 1-8 of 8.

Results/Page 10 | Sort Items by Relevance In order Descending Authors/record All Update

Item hits:

Issue Date	Title	Author(s)
3-Mar-2013	Designing single-window search service for electronic theses and dissertations through metadata harvesting	Sarkar, Prasenjit; Mukhopadhyay, Parthasarathi
4-Mar-2013	The Current State of Open Access Repository Interoperability (2012)	Confederation Open Access Repositories
4-Mar-2013	DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE	Roy, Bijan Kumar
4-Mar-2013	Pathfinder Research on Web-based Repositories: FINAL REPORT	Ware, Mark
4-Mar-2013	CASLIN 2009: Institutional Online Repositories and Open Access	University of West Bohemia
3-Mar-2013	An Analytical Study of Institutional Digital Repositories in India	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Open Access to scholarly information in India: Trends and Developments	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi

Fig. 6.2.2.17: Boolean Search by ‘OR’

- Either ‘AND’ or ‘&&’ can be used for Boolean ‘AND’. It will retrieve documents where both the terms ("repository" and "archive") exist anywhere in the text of a single document. To search for documents that contain the word "repository" and "archive" use the query: "repository" AND "archive".

Search Results

Search: All of DSpace
 for "repository" AND "archive" Go

Results 1-1 of 1.

Results/Page 10 | Sort Items by Relevance In order Descending Authors/record All Update

Item hits:

Issue Date	Title	Author(s)
3-Mar-2013	Designing single-window search service for electronic theses and dissertations through metadata harvesting	Sarkar, Prasenjit; Mukhopadhyay, Parthasarathi

Fig. 6.2.2.18: Boolean Search by ‘AND’

- Either ‘NOT’ or ‘!’ can be used for Boolean ‘NOT’. It is used to exclude works containing the word following this operator, e.g. in this case it will retrieve documents that do not contain the term “archive”. The NOT operator cannot be used with just one term. To search for documents that contain the word "repository" not "archive" use the query: "repository" NOT "archive".

Search Results

Search: All of DSpace
 for ((repository) NOT (archive)) Go

Results 1-6 of 6.

Results/Page 10 | Sort Items by Relevance In order Descending Authors/record All Update Export metadata

Item hits:

Issue Date	Title	Author(s)
4-Mar-2013	The Current State of Open Access Repository Interoperability (2012)	Confederation Open Access Repositories
4-Mar-2013	DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE	Roy, Bijan Kumar
4-Mar-2013	Pathfinder Research on Web-based Repositories: FINAL REPORT	Ware, Mark
4-Mar-2013	CASLIN 2009: Institutional Online Repositories and Open Access	University of West Bohemia
3-Mar-2013	An Analytical Study of Institutional Digital Repositories in India	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi
3-Mar-2013	Open Access Repositories in Asia: From SAARC to Asian Tigers	Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi

Fig. 6.2.2.19: Boolean Search by ‘NOT’

L. Searching Item by Handle

Handle is considered crucial for any repository system that citations to archived material, whether found in printed articles or online, remain valid for long periods. DSpace uses Handles primarily as a means of assigning globally unique identifiers to objects. It is a name for a resource that will remain the same regardless of where the resource is located. Presently, Handles are assigned to Communities, Collections, and Items. But bundles and bitstreams are not assigned Handles. BURA supports searching all Communities (Fig. 6.2.2.22), Sub-communities (Fig. 6.2.2.23), Collections (Fig. 6.2.2.24) and Items (digital documents) using handle assigned to it. User can also restrict search within a particular Community or Collections and the process is shown here through five screen snapshots (Fig. 6.2.2.20 through Fig. 6.2.2.24).

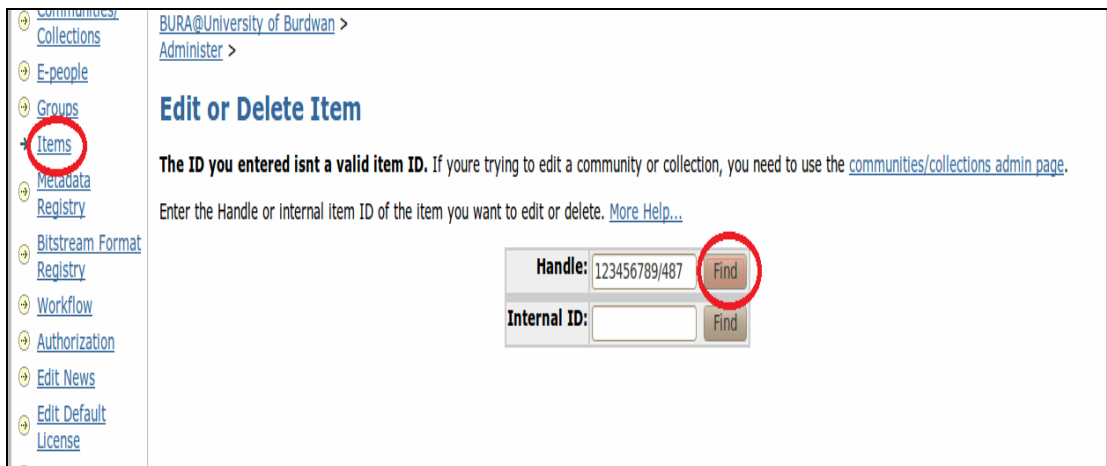


Fig. 6.2.2.20: Searching Item using Handle

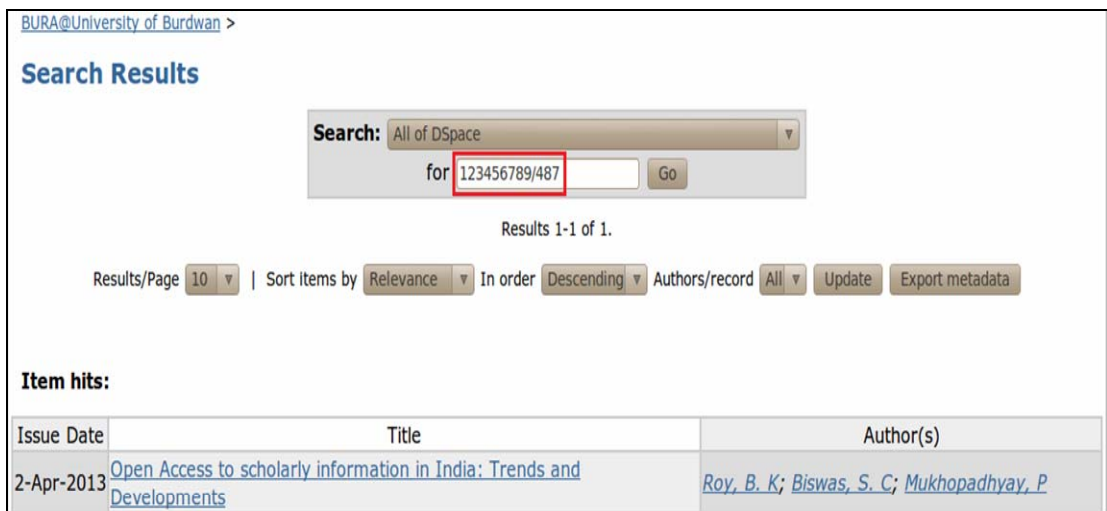


Fig. 6.2.2.21: Display of Result using Handle (Item)

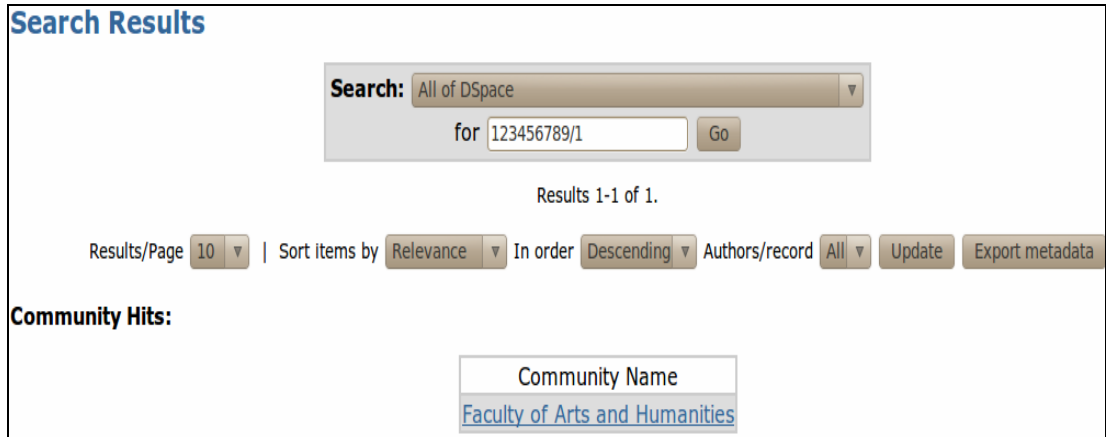


Fig. 6.2.2.22: Searching Community using Handle

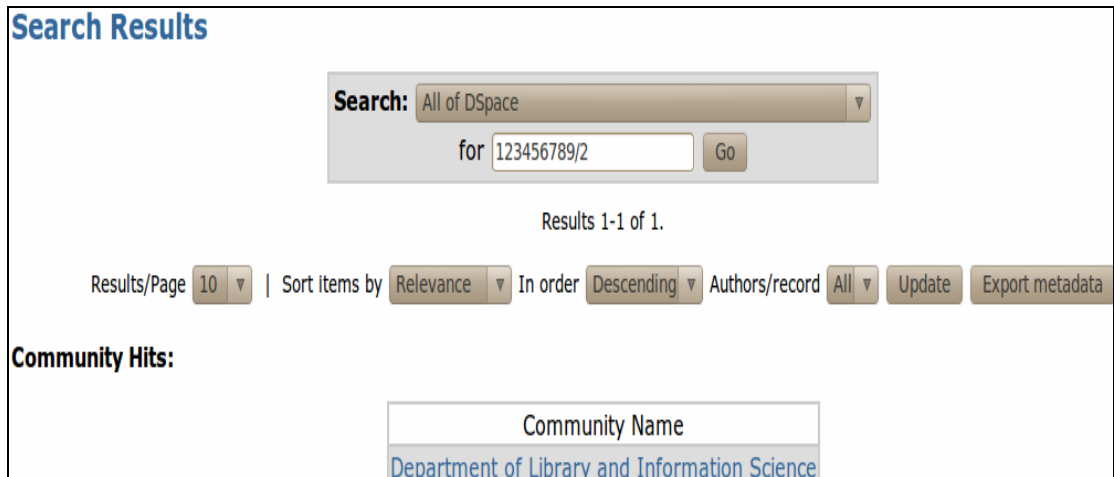


Fig. 6.2.2.23: Searching Sub-community using Handle



Fig. 6.2.2.24: Searching Collection using Handle

6.3. Multilingual Features

Repository system must be Unicode compliant to support multilingual features and must support searching and browsing of different regional/local languages. Multiple languages should be supported in the user interface, in the metadata fields and in the digital contents. BURA has developed an Indic-script based Unicode-compliant multilingual user interface (Fig. 6.3) that supports not only browsing, searching and retrieving of various regional languages (here Bengali) languages but also allows to perform different administrative operations such as creating, modifying, removing and maintaining Communities, Sub-communities and Collections, user registration, password management, creating and maintaining E-Peoples and E-Groups, withdraw and removal of items etc. The Bengali script based browsing and searching of resources in BURA (on Bengali Collections) is demonstrated here through different screen snapshots.

বর্ধমান বিশ্ববিদ্যালয় গবেষণা সংগ্রহ - সম্প্রদায়ের তালিকা

বর্ধমান বিশ্ববিদ্যালয় গবেষণা সংগ্রহ

বর্ধমান বিশ্ববিদ্যালয় গবেষণা সংগ্রহশালার নতুন ইন্টারফেসে (ম্যানাকিন) আপনাদের স্বাগত জানাই। এই ডিজিটাল ভান্ডার পদ্ধতিটি বিশ্ববিদ্যালয়ের গবেষণা সংক্রান্ত দ্রব্যসামগ্রী নিয়ন্ত্রণ, সঞ্চয়, পরস্পর সজ্জাকরন, সংরক্ষন এবং বিতরণ করে। এই সংরক্ষন পদ্ধতি বিশ্ববিদ্যালয়ের প্রদত্ত জ্ঞান-ভাণ্ডার এবং গবেষণা সংক্রান্ত তথ্যাদি সংরক্ষন করে; পাক্তিত্যপূর্ণ যোগাযোগ করতে সাহায্য করে।

গবেষণা সংগ্রহ তালিকা

একটি সম্প্রদায়ের অন্তর্ভুক্ত সংগ্রহের মধ্যে খুঁজুন।

- [Faculty of Arts and Humanities](#)
- [Faculty of Infrastructural Facilities](#)
- [Faculty of Science](#)

গবেষণাগারে অনুসন্ধান করুন

অনুসন্ধানের জন্য নিম্নের বক্সের মধ্যে কিছু পাঠ্য লিখুন।

অনুসন্ধান করুন

[বিস্তৃত অনুসন্ধান](#)

খুঁজুন

- [সমগ্র ডিসপেন্স](#)
 - [সম্প্রদায়গুলি এবং সংগ্রহগুলি](#)
 - [প্রকাশিত তারিখ দ্বারা](#)
 - [লেখকগন](#)
 - [আখ্যা](#)
 - [বিষয়গুলি](#)

আমার খাতা

- [লগ-ইন](#)
- [নথিভুক্তকরন](#)

Fig. 6.3: Bengali Script based User Interface of BURA

A. Browsing of Resources

Any Community information record that is processed and store in IDR Cluster of the software framework can be linked with browsing panel of BURA user interface. User can pick up any search syntax (e.g. Community, Collection, author, title, subject, date etc.) given in the panel to browsing resources and is demonstrated here through different screen snapshots (Fig. 6.3.1 through Fig. 6.3.6).

অনুসন্ধান

সমগ্র পাঠ্য অনুসন্ধান করুন:

ফলাফল/পএ বাছাই করুন উদ্দেশ্য

আপনার জিজ্ঞাসা "ঠাকুর" প্রদর্শন করেছে 4 ফলাফল।

সম্প্রদায়ের জন্য অনুসন্ধানের ফলাফল: Faculty of Arts and Humanities

এখন নথিপত্র দেখানো হবে 1-4 of 4

1

[গীতাজলি : বাংলা ইংরেজি একত্রে](#)
রবীন্দ্রনাথ, ঠাকুর (2013-05-01)

[গীতাজলি](#)
ঠাকুর, রবীন্দ্রনাথ (2013-05-15)

[আজকের যুগে রবীন্দ্রনাথের প্রাসঙ্গিকতা](#)
বন্দোপাধ্যায়, হিমবন্ত (2013-05-15)

[কেন রবীন্দ্রনাথ ?](#)
চক্রবর্তী, বিকাশ (2013-05-15)

Fig. 6.3.1: Browse by Community (Bengali Collections)

অনুসন্ধান

সমগ্র পাঠ্য অনুসন্ধান করুন:

ফলাফল/পএ বাছাই করুন উদ্দেশ্য

আপনার জিজ্ঞাসা "ঠাকুর" প্রদর্শন করেছে 2ফলাফল।

সংগ্রহের জন্য অনুসন্ধানের ফলাফল: Faculty Publications (Dept. of Bengali)

এখন নথিপত্র দেখানো হবে 1-2 of 2

1

[আজকের যুগে রবীন্দ্রনাথের প্রাসঙ্গিকতা](#)
বন্দোপাধ্যায়, হিমবন্ত (2013-05-15)

[কেন রবীন্দ্রনাথ ?](#)
চক্রবর্তী, বিকাশ (2013-05-15)

Fig. 6.3.2: Browse by Collection (Bengali Collections)

খুঁজুন প্রকাশিত তারিখ দ্বারা

নিবন্ধের বিশেষ স্থানে চুকে পড়ুন: (মাস নির্বাচন করুন) (বৎসর নির্বাচন করুন)

অথবা একটি বৎসরের মধ্যে টাইপ করুন:

বাছাই করুন: প্রকাশিত তারিখ আদেশ: ক্রমোচ্চ ফলাফল: 20 সাম্প্রতিক তথ্য

এখন নথিপত্র দেখানো হবে 1-20 of 251 [পরের পাতা](#)

- [Designing single-window search service for electronic theses and dissertations through metadata harvesting](#)
Sarkar, Prasenjit; Mukhopadhyay, Parthasarathi (2013-03-03)
- [Open Access Repositories in Asia: From SAARC to Asian Tigers](#)
Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi (2013-03-03)
- [Draft Syllabus for M. Phil in Library and Information Science](#)
Department of Library and Information Science (2013-03-03)
- [Open Source Software for Libraries: A Trend Report](#)
Amin, Saiful (2013-03-03)
- [An Analytical Study of Institutional Digital Repositories in India](#)
Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi (2013-03-03)
- [Open Access to scholarly information in India: Trends and Developments](#)
Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi (2013-03-03)
- [Pathfinder Research on Web-based Repositories: FINAL REPORT](#)
Ware, Mark (2013-03-04)
- [DESIGNING INSTITUTIONAL DIGITAL REPOSITORY FOR THE UNIVERSITY OF BURDWAN: A FLOSS BASED PROTOTYPE](#)

Fig. 6.3.3: Browse by Date (Bengali Collections)

খুঁজুন লেখক দ্বারা

0-9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

অথবা প্রথম কিছু অক্ষর লিখুন:

আদেশ: ক্রমোচ্চ ফলাফল: 20 সাম্প্রতিক তথ্য

এখন নথিপত্র দেখানো হবে 1-20 of 174 [পরের পাতা](#)

লেখকের নাম

- [Acharya, Somen](#)
- [Agrawal, Rajesh](#)
- [Al-Shimmary, Mushtaq A. H.](#)
- [Ameer, Mohammed Abdul](#)
- [Amin, Saiful](#)
- [Arriaga, Ismael Rosas](#)
- [Bagchi, Pradipta](#)
- [Bali, Kalika](#)
- [Bebbington, D W](#)
- [BHARATHIDASAN UNIVERSITY](#)
- [Bharat Immunologicals and Biologicals Corporation Limited](#)
- [BISARIA, V S](#)
- [Biswas, S. C](#)
- [Biswas, Subal Chandra](#)

Fig. 6.3.4: Browse by Author (Bengali Collections)

খুঁজুন আখ্যা দ্বারা

O-9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

অথবা প্রথম কিছু অক্ষর লিখুন:

বাছাই করুন: আদেশ: ফলাফল:

এখন নথিপত্র দেখানো হবে 1-20 of 251 [পরের পাতা](#)

[9 A Case Study:: Server Performance Measurement for E-Learning System in Campus Environment](#)
Ismaill, Mohd Nazrii (2013-03-13)

[Achievement of Department of Chemistry in the International Year of Chemistry The](#)
Department of Chemistry, Jadavpur University (2013-03-09)

[Advertisement for the temporary position : U.G.C. Project](#)
DEPARTMENT OF BUSINESS ADMINISTRATION UNIVERSITY OF LUCKNOW (2013-03-13)

[AGRI-ENVIRONMENTAL SCIENCE](#)
Department of Forest and Environmental Science and Technology (2013-03-14)

[Agro-Tourism A Specialized Rural Tourism: Innovative Product Of Rural Market](#)
Joshi, Paresh V. (2013-03-15)

[Algorithmic Solution of Stochastic Differential Equations](#)
Schurz, Henri (2013-03-15)

[An Analytical Program Contents Study of Community Radios Functioning in National Capital Territory of Delhi \(India\)](#)
Kishore, Devesh; Agrawal, Rajesh (2013-03-15)

[An Analytical Study of Institutional Digital Repositories In India](#)
Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi

Fig. 6.3.5: Browse by Title (Bengali Collections)

খুঁজুন বিষয় দ্বারা

O-9 A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

অথবা প্রথম কিছু অক্ষর লিখুন:

আদেশ: ফলাফল:

এখন নথিপত্র দেখানো হবে 1-20 of 190 [পরের পাতা](#)

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[Bengali](#)

[bengali](#)

[Bengali literature](#)

[Bioethics](#)

[biology](#)

Fig. 6.3.6: Browse by Subject (Bengali Collections)

B. Searching of Resources

The following screen snapshots (Fig. 6.3.7 through Fig. 6.3.10) demonstrate Bengali language based search capability of the interface generated by BURA. Results retrieved against a search query can be displayed below in four screen snapshots.

অনুসন্ধান

অনুসন্ধানের পরিধি:

সমগ্র পাঠ্য অনুসন্ধান করুন:

ফলাফল/পএ বাছাই করুন উদ্দেশ্য

আপনার জিজ্ঞাসা "ঠাকুর" প্রদর্শন করেছে 4 ফলাফল।

অনুসন্ধানের ফলাফল

এখন নথিপএ দেখানো হবে 1-4 of 4

1

গীতাজলি : বাংলা ইংরেজি একত্রে
রবীন্দ্রনাথ, ঠাকুর (2013-05-01)

গীতাজলি
ঠাকুর, রবীন্দ্রনাথ (2013-05-15)

আজকের যুগে রবীন্দ্রনাথের প্রাসঙ্গিকতা
বন্দোপাধ্যায়, হিমব্রত (2013-05-15)

কেন রবীন্দ্রনাথ ?
চক্রবর্তী, বিকাশ (2013-05-15)

Fig. 6.3.7: Display of Search Results in BURA (Bengali Collections)

আজকের যুগে রবীন্দ্রনাথের প্রাসঙ্গিকতা

লিপিবদ্ধ সমগ্র বিষয়বস্তু দেখানো হবে

আখ্যা: আজকের যুগে রবীন্দ্রনাথের প্রাসঙ্গিকতা

লেখক: বন্দোপাধ্যায়, হিমব্রত

সংক্ষিপ্তসার: রবীন্দ্রনাথ ঠাকুরের রচনা ও সৃষ্টির প্রয়োজনীয়তা।

বর্ণনা: কে কে দাস কলেজ আয়োজিত জাতীয় আলোচনাচক্র (মার্চ ১০-১১, ২০১১) বিষয় : সাম্প্রতিকতার আলোকে রবীন্দ্রনাথ।

ইউনিফর্ম রিসোর্স লোকেটর: <http://hdl.handle.net/123456789/510>

তারিখ: 2013-05-15

এই তালিকাভুক্ত বিষয়ের অন্তর্ভুক্ত নথিপএ

নথিপএ	আয়তন	বিন্যাস	দেখুন
pg1.jpg	1.603Mb	জেপিইজি ইমজ	দেখুন/খুলুন
pg2.jpg	1.676Mb	জেপিইজি ইমজ	দেখুন/খুলুন
pg3.jpg	968.7Kb	জেপিইজি ইমজ	দেখুন/খুলুন

এই তালিকাভুক্ত বিষয়টি নিম্নলিখিত সংগ্রহগুলির মধ্যে দৃশ্যমান হয়েছে

- Faculty Publications (Dept. of Bengali)

লিপিবদ্ধ সমগ্র বিষয়বস্তু দেখানো হবে

Fig. 6.3.8: Short Display of Record details (Bengali Collections)

অনুসন্ধান

অনুসন্ধানের পরিধি: সমস্ত ডিসপেন্স

সমগ্র পাঠ্য অনুসন্ধান করুন: গবেষণাপত্র

ফলাফল/পএ 10 বাছাই করুন প্রাসঙ্গিক উদ্দেশ্য অবরোধ

সময়

আপনার জিজ্ঞাসা "গবেষণাপত্র" প্রদর্শন করেছে 4 ফলাফল।

অনুসন্ধানের ফলাফল

এখন নথিপত্র দেখানো হবে 1-4 of 4

1

[বাংলা প্রকাশনা ও তথ্য প্রকাশনা](#)
বসু, বাদল (2013-06-15)

[চিত্রী রবীন্দ্রনাথ](#)
বন্দোপাধ্যায়, সোমেন্দ্রনাথ (2013-05-15)

[আজকের যুগে রবীন্দ্রনাথের প্রাসঙ্গিকতা](#)
বন্দোপাধ্যায়, হিমব্রত (2013-05-15)

[কেন রবীন্দ্রনাথ ?](#)
চক্রবর্তী, বিকাশ (2013-05-15)

Fig. 6.3.9: Display of Search Results in Bengali

কেন রবীন্দ্রনাথ ?

[লিপিবদ্ধ সমগ্র বিষয়বস্তু দেখানো হবে](#)

আখ্যা: কেন রবীন্দ্রনাথ ?

লেখক: চক্রবর্তী, বিকাশ

সংক্ষিপ্তসার: সাম্প্রতিকতার আলোকে রবীন্দ্রনাথ ঠাকুরের প্রয়োজনীয়তা।

বর্ণনা: কে কে দাস কলেজ আয়োজিত জাতীয় আলোচনাচক্র (মার্চ ১০-১১, ২০১১) বিষয় : সাম্প্রতিকতার আলোকে রবীন্দ্রনাথ।

ইউনিফর্ম রিসোর্স লোকেশন: <http://hdl.handle.net/123456789/509>

তারিখ: 2013-05-15

এই তালিকাভুক্ত বিষয়ের অন্তর্ভুক্ত নথিপত্র

নথিপত্র	আয়তন	বিন্যাস	দেখুন
pg1.jpg	1.666Mb	জেপিইজ ইমজ	দেখুন/খুলুন
pg2.jpg	1.802Mb	জেপিইজ ইমজ	দেখুন/খুলুন
pg3.jpg	1.727Mb	জেপিইজ ইমজ	দেখুন/খুলুন

এই তালিকাভুক্ত বিষয়টি নিম্নলিখিত সংগ্রহগুলির মধ্যে দৃশ্যমান হয়েছে

- Faculty Publications (Dept. of Bengali)

[লিপিবদ্ধ সমগ্র বিষয়বস্তু দেখানো হবে](#)

Fig. 6.3.10: Short Display of Record details in Bengali

Community, Collection or Item in BURA can be searched by using Handle or internal ID assigned to it and is shown in two screen snapshots (Fig. 6.3.11 & Fig. 6.3.12).

The screenshot shows the search interface for a collection. The title is "অনুসন্ধান" (Search). The search criteria are: "অনুসন্ধানের পরিধি:" (Search Scope) set to "সমস্ত ডিসপেন্স" (All Disposition), "সমগ্র পাঠ্য অনুসন্ধান করুন:" (Search for full text) with the handle "123456789/43". The results show 10 items per page, sorted by "বাস্তবিক" (Actual) and "উদ্দেশ্য" (Purpose) set to "অববাহা" (Unsubscribed). The search button is "সন্ধান" (Search). The results section shows "এখন নথিপত্র দেখানো হবে 1-1 of 1" (1 item displayed) and "সম্প্রদায় অথবা সংগ্রহগুলি আপনার জিজ্ঞাসার সঙ্গে মানানসই হয়েছে" (Community or collections match your query). The result is "Faculty Publications (Dept. of Bengali)".

Fig. 6.3.11: Searching Collection by Handle or ID

The screenshot shows the search interface for an item. The title is "অনুসন্ধান" (Search). The search criteria are: "অনুসন্ধানের পরিধি:" (Search Scope) set to "সমস্ত ডিসপেন্স" (All Disposition), "সমগ্র পাঠ্য অনুসন্ধান করুন:" (Search for full text) with the handle "123456789/18". The results show 10 items per page, sorted by "বাস্তবিক" (Actual) and "উদ্দেশ্য" (Purpose) set to "অববাহা" (Unsubscribed). The search button is "সন্ধান" (Search). The results section shows "এখন নথিপত্র দেখানো হবে 1-1 of 1" (1 item displayed) and "সম্প্রদায় অথবা সংগ্রহগুলি আপনার জিজ্ঞাসার সঙ্গে মানানসই হয়েছে" (Community or collections match your query). The result is "An Analytical Study of Institutional Digital Repositories in India" by Roy, Bijan Kumar; Biswas, Subal Chandra; Mukhopadhyay, Parthasarathi (2013-03-03).

Fig. 6.3.12: Display of Items by Handle or ID

C. Advanced Searching

Advanced search mechanism can be accessed from User Interface (Fig. 6.3) by simply clicking the corresponding link *'Advanced Search'* (here বিস্তৃত অনুসন্ধান). This window (Fig. 6.3.13) is supported by drop down menu list and provides facility of Boolean operators supported field level searching (e.g. by subject, title, abstracts, keywords, language etc.). In advanced search, user can restrict search by selecting

appropriate fields using drop-down menu and Boolean operators "AND" (এবং), "OR" (অথবা) or "NOT" (নয়) can be used to restrict search to a specific field.

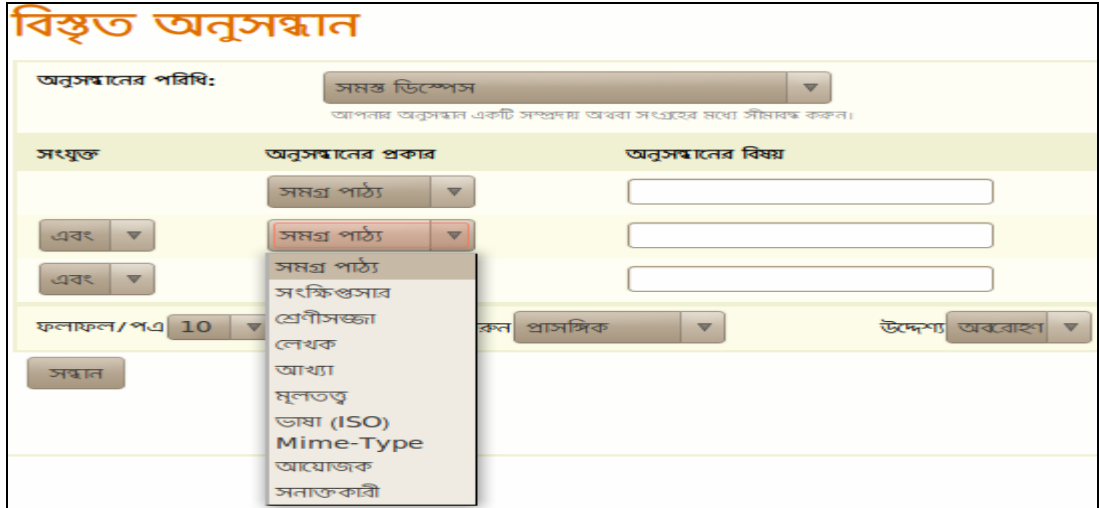


Fig. 6.3.13: Bengali Script based Advanced Search Interface

The process of advanced searching using different search syntax is shown here through four different screen snapshots (Fig. 6.3.14 through Fig. 6.3.17).



Fig. 6.3.14: Bengali Script based Advanced Search

গীতাজলি : বাংলা ইংরেজি একত্রে

[লিপিবদ্ধ সমগ্র বিষয়বস্তু দেখানো হবে](#)

আখ্যা:	গীতাজলি : বাংলা ইংরেজি একত্রে
লেখক:	রবীন্দ্রনাথ, ঠাকুর
সংক্ষিপ্তসার:	গীতাজলি থেকে রবীন্দ্রনাথ ঠাকুর কর্তৃক অনুবাদিত বাংলা কবিতা সংগ্রহ
ইউনিফর্ম রিসোর্স লোকেটর:	http://hdl.handle.net/123456789/503
তারিখ:	2013-05-01

এই তালিকাভুক্ত বিষয়ের অন্তর্ভুক্ত নথিপত্র

নথিপত্র	আয়তন	বিন্যাস	দেখুন
1038-Bengali-Poem-of-Rabindranath-Tagore.gif	18.98Kb	জিআইএফ ইমেজ	দেখুন/খুলুন
pran.gif	7.974Kb	জিআইএফ ইমেজ	দেখুন/খুলুন
prarthona.gif	5.205Kb	জিআইএফ ইমেজ	দেখুন/খুলুন

এই তালিকাভুক্ত বিষয়টি নিম্নলিখিত সংগ্রহগুলির মধ্যে দৃশ্যমান হয়েছে

- [Extension Services and Departmental Products \(Dept. of Bengali\)](#)

[লিপিবদ্ধ সমগ্র বিষয়বস্তু দেখানো হবে](#)

Fig. 6.3.15: Display of Advanced Search Results in Bengali

বিস্তৃত অনুসন্ধান

অনুসন্ধানের পদ্ধতি: ▼
আপনার অনুসন্ধান একটি সম্প্রদায় অথবা সংগ্রহের মধ্যে সীমাবদ্ধ করুন।

সংযুক্ত	অনুসন্ধানের প্রকার	অনুসন্ধানের বিষয়
	<input type="text" value="লেখক"/> ▼	<input type="text" value="বন্দোপাধ্যায়"/>
<input type="text" value="অথবা"/> ▼	<input type="text" value="আখ্যা"/> ▼	<input type="text" value="বাংলা সাহিত্য"/>
<input type="text" value="নয়"/> ▼	<input type="text" value="ভাষা (ISO)"/> ▼	<input type="text" value="ইংরেজী"/>

ফলাফল/পত্র ▼ বাছাই করুন ▼ উদ্দেশ্য ▼

আপনার জিজ্ঞাসা "(author:বন্দোপাধ্যায়) OR (title:বাংলা title:সাহিত্য) NOT (language:ইংরেজী)" প্রদর্শন করেছে 4 ফলাফল।

অনুসন্ধানের ফলাফল

এখন নথিপত্র দেখানো হবে 1-4 of 4

আজকের যুগে রবীন্দ্রনাথের প্রাসঙ্গিকতা
বন্দোপাধ্যায়, হিমব্রত (2013-05-15)
চিত্রী রবীন্দ্রনাথ
বন্দোপাধ্যায়, সোমেন্দ্রনাথ (2013-05-15)
গীতাজলি : বাংলা ইংরেজি একত্রে
রবীন্দ্রনাথ, ঠাকুর (2013-05-01)
বাংলা প্রকাশনা ও তথ্য প্রকাশনা
বসু, বাদল (2013-06-15)

Fig. 6.3.16: Display of Search Results in Bengali (Advanced Search)

চিত্রী রবীন্দ্রনাথ

[লিপিবদ্ধ সমগ্র বিষয়বস্তু দেখানো হবে](#)

আখ্যা:	চিত্রী রবীন্দ্রনাথ
লেখক:	বন্দোপাধ্যায়, সোমেন্দ্রনাথ
সংক্ষিপ্তসার:	চিত্রবিদ্যায় রবীন্দ্রনাথের অবদান।
বর্ণনা:	কে কে দাস কলেজ আয়োজিত জাতীয় আলোচনাচক্র (মার্চ ১০-১১, ২০১১) বিষয় : সাম্প্রতিকতার আলোকে রবীন্দ্রনাথ।
ইউনিফর্ম রিসোর্স লোকেটর:	http://hdl.handle.net/123456789/511
তারিখ:	2013-05-15

এই তালিকাভুক্ত বিষয়ের অন্তর্ভুক্ত নথিপত্র

নথিপত্র	আয়তন	বিন্যাস	দেখুন
pg1.jpg	1.545Mb	জেপিইজি ইমেজ	দেখুন/খুলুন
pg2.jpg	949.4Kb	জেপিইজি ইমেজ	দেখুন/খুলুন

এই তালিকাভুক্ত বিষয়টি নিম্নলিখিত সংগ্রহগুলির মধ্যে দৃশ্যমান হয়েছে

- [Faculty Publications \(Dept. of Bengali\)](#)

[লিপিবদ্ধ সমগ্র বিষয়বস্তু দেখানো হবে](#)

Fig. 6.3.17: Short Display of Record details in Bengali (Advanced Search)

D. User Registration Process in BURA

Registration can be done by clicking of ‘*Registration*’ (here *নথিভুক্তকরণ*) button at the right hand side of the window (Fig. 6.3). The process of user registration is shown here through three screen snapshots (Fig. 6.3.18 through Fig. 6.3.22).

নতুন ব্যবহারকারীর নথিভুক্তকরণ

[ই-মেল পরীক্ষাকরণ](#) → [পরিচায়িকা রচনা করুন](#) → [শেষ](#)

একটি খাতা নথিভুক্ত করুন ই-মেলের সাহায্যে সংগ্রহের সাম্প্রতিক তথ্য জানতে এবং ডিস্কেসে নতুন তালিকাভুক্ত বিষয় যুক্ত হওয়ার ব্যাপারে।

ই-মেলের ঠিকানা:

এই ঠিকানাটি পরীক্ষিত এবং আপনার লগ-ইন নাম হিসাবে ব্যবহার করতে পারেন।

[নথিভুক্তকরণ](#)

[সমগ্র](#)

[বিস্তৃত অনুসন্ধান](#)

খুঁজুন

- সমগ্র ডিস্কেস
 - [সম্প্রদায়গুলি এবং সংগ্রহগুলি](#)
 - [প্রকাশিত তারিখ দ্বারা](#)
 - [লেখকগণ](#)
 - [আখ্যা](#)
 - [বিষয়গুলি](#)

আমার খাতা

- [লগ-ইন](#)
- [নথিভুক্তকরণ](#)

Fig. 6.3.18: New User Registration

The system sends a message having a link (Fig. 6.3.19) to the user and it has to be opened to have the registration form.

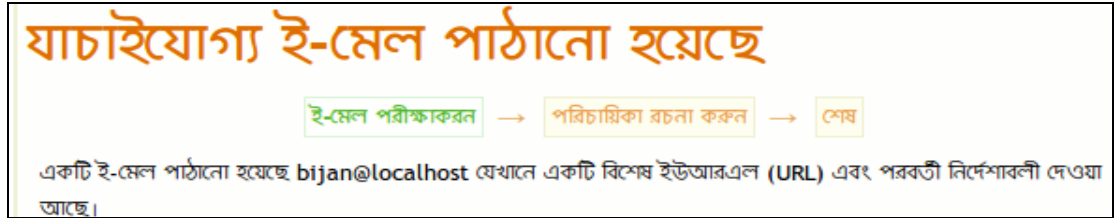


Fig. 6.3.19: New User Registration Mail

If the E-mail supplied by the user is already used, system sends a caution message to the user (Fig. 6.3.20).

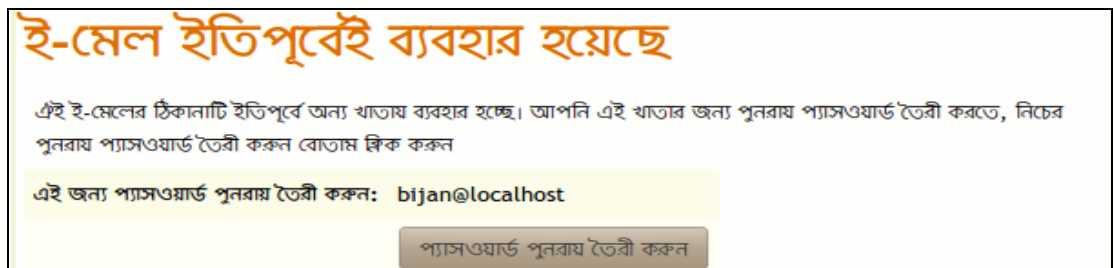


Fig. 6.3.20: Mail already used by User

This registration form (Fig. 6.3.21) can be displayed by clicking on the link containing a URL and user related data that is collected by this registration process are stored in database.

Fig. 6.3.21: Registration Form Fill Up

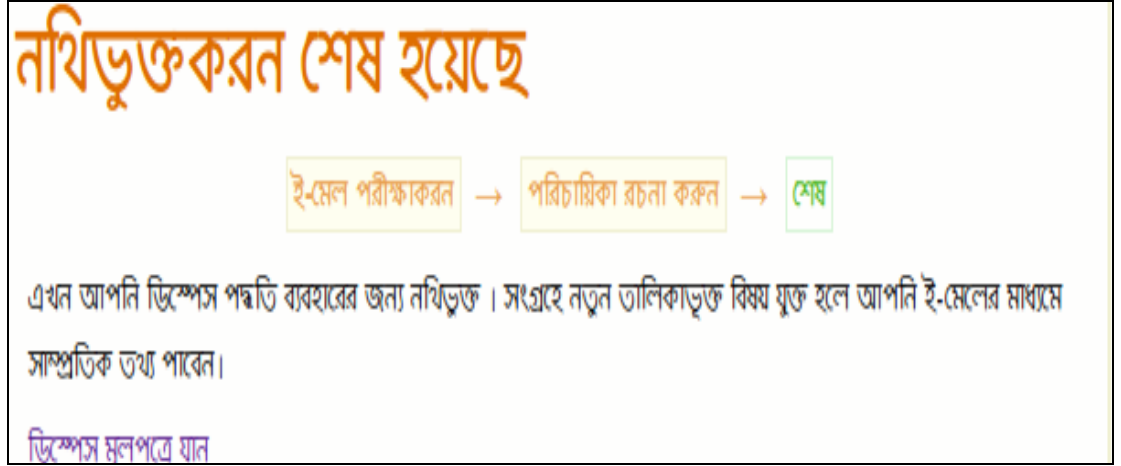


Fig. 6.3.22: Registration Completed

E. E-Person and Group Management

Any time, addition, deletion of E-person or Group is possible and is shown here through six screen snapshots (Fig. 6.3.23 through Fig. 6.3.28). The programme displays the form (Fig. 6.3.24) needs to be filled up by new E-person and finally shows the results (Fig. 6.3.25). In the same way new group can be created and is shown through three screen snapshots (Fig. 6.3.26 through Fig. 6.3.28).

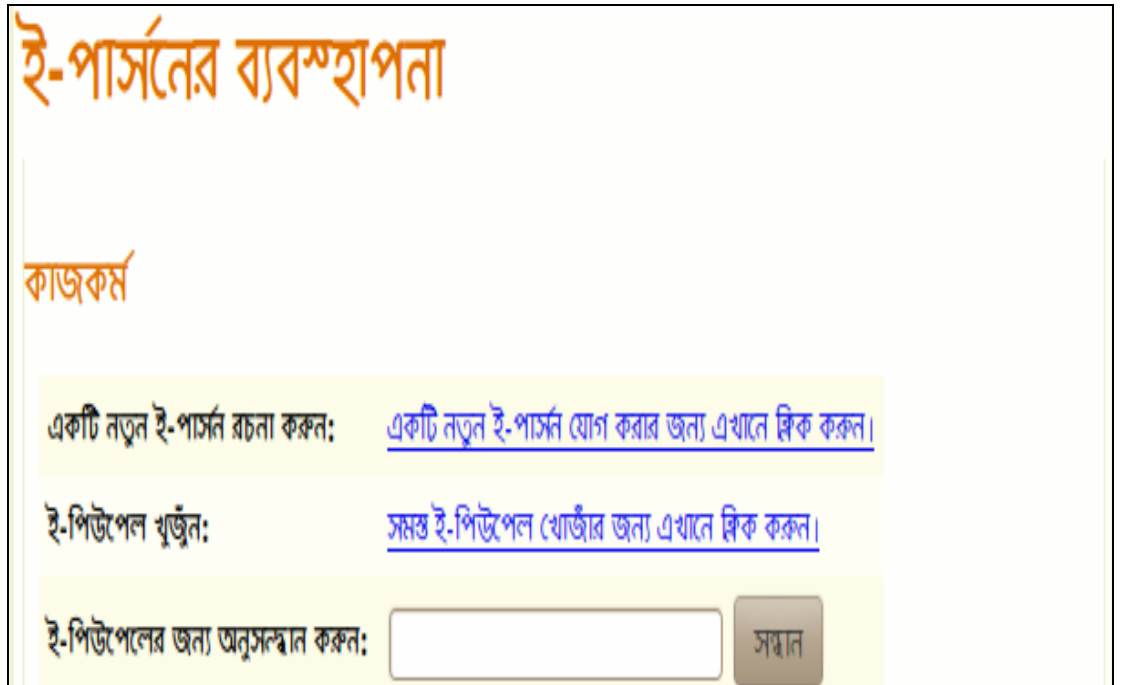


Fig. 6.3.23: E-person Management

একটি নতুন ই-পার্সন রচনা করুন

নতুন ই-পার্সনের তথ্য:

ই-মেলের ঠিকানা:

প্রথম নাম:

শেষের নাম:

সংযোগকারী টেলিফোন নং:

লগ ইন করা উচিত:

প্রশংসাপত্র প্রয়োজন:

Fig. 6.3.24: E-person Form

অনুসন্ধানের ফলাফল

	আই ডি	নাম	ই-মেল
<input type="checkbox"/>	11	Subal Ch. Biswas	scb@localhost
<input type="checkbox"/>	1	Parthasarathi Mukhopadhyay	dspace@localhost
<input type="checkbox"/>	8	Kakoli Roy	kakoli@localhost
<input type="checkbox"/>	2	Tulu Roy	tulu@localhost
<input type="checkbox"/>	12	বিজন রায়	বিজন@localhost

Fig. 6.3.25: Display of Results of New E-person

গোষ্ঠীর ব্যবস্থাপনা

কাজকর্ম

একটি নতুন গোষ্ঠী রচনা করুন: [একটি নতুন গোষ্ঠী যোগ করার জন্য এখানে ক্লিক করুন।](#)

গোষ্ঠী খুঁজুন: [সমস্ত গোষ্ঠী খোঁজার জন্য এখানে ক্লিক করুন।](#)

গোষ্ঠীগুলির জন্য অনুসন্ধান করুন:

Fig. 6.3.26: Group Management

গোষ্ঠীর সম্পাদক: নতুন গোষ্ঠী

গোষ্ঠীর নাম পরিবর্তন করুন:

সদস্যদের অনুসন্ধান করুন যুক্ত করতে:

Fig. 6.3.27: Addition of New Group

অনুসন্ধানের ফলাফল

	আই. ডি.	নাম	সদস্যগণ	সম্প্রদায়/সংগ্রহ
<input type="checkbox"/>	423	Research Scholars (Dept. of LIsc)	-	

Fig. 6.3.28: Display of Results of New Group

F. Profile Editing

In any time user profile can be edited and modified by clicking on button ‘*Edit Profile*’ (Fig. 6.3.35) (here পরিচায়িকা). A click on this button displays the form (Fig. 6.3.29) needs to be updated by concerned E-person and the next subsequent window (Fig. 6.3.30) displays the message of updating profile.

পরিচায়িকাটিতে সাম্প্রতিক তথ্য দিন

সনাক্তকরণ

ই-মেলের ঠিকানা: bijan@localhost

প্রথম নাম:

শেষের নাম:

সংযোগকারী টেলিফোন নং:

ভাষা:

অনুর্ভুক্তিকরণ

আপনি সংগ্রহ বাছাই করতে পারেন ই-মেল বার্তার মাধ্যমে নিয়মিত নতুন তালিকাভুক্ত বিষয় যুক্ত সংক্রান্ত তথ্য জানার জন্য। আপনি ইচ্ছামত কয়েকটি অথবা যত খুশি সংগ্রহ বাছাই করতে পারেন। এই ই-মেল বার্তা পেতে পারেন প্রতিটি সংগ্রহের অর এস এস ফীড (RSS feed) ব্যবহার করে।

ই-মেলের অনুর্ভুক্তিকরণ:

নিরাপত্তা

ইচ্ছা অনুযায়ী, আপনি নিচের বক্সে একটি নতুন প্যাসওয়ার্ড লিখুন, এবং সুনিশ্চিত করুন দ্বিতীয় বক্সে পুনরায় লিখে। এটি কমপক্ষে ৬টি অক্ষরের মধ্যে হতে হবে।

প্যাসওয়ার্ড:

সুনিশ্চিত করার জন্য পুনরায় লিখুন:

Fig. 6.3.29: Profile Update Form

পরিচায়িকায় সাম্প্রতিক তথ্য দেওয়া হয়েছে

আপনার পরিচায়িকায় সাম্প্রতিক তথ্য দেওয়া হয়েছে

[ডিসেম্পস মূলপাত্রে যান](#)

Fig. 6.3.30: Profile Updated

G. Password Management

Authorized users can only use the system and authentication is done by requesting user name (e.g. ID) and password. The forgotten password link allows user to retrieve the forgotten password or to set a new password. The process of changing password is shown here through four screen snapshots (Fig. 6.3.31 through Fig. 6.3.34). The system first displays a small window (Fig. 6.3.31) for entering user ID or login name which user had used at the time of registration.

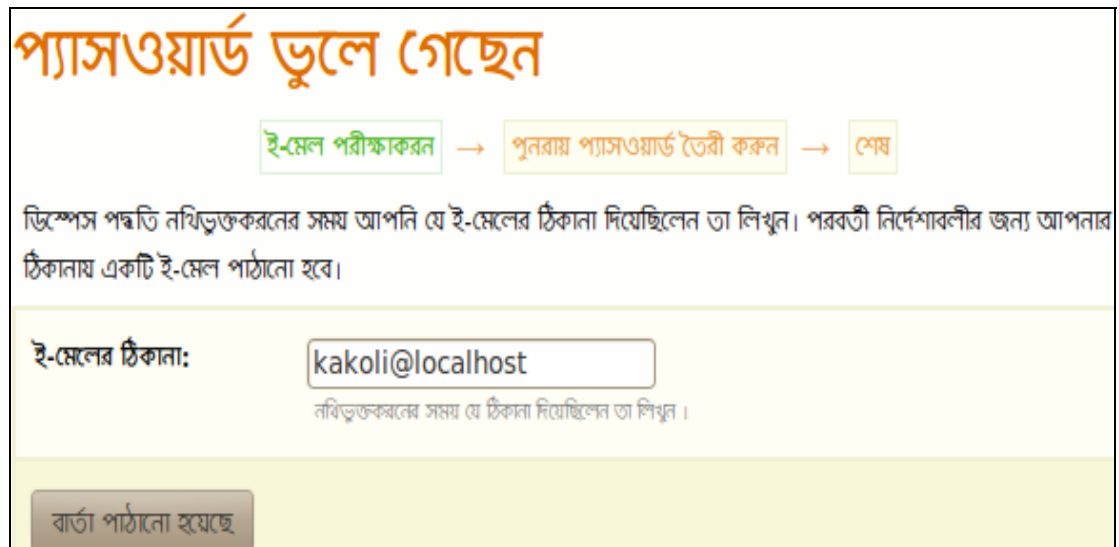


Fig. 6.3.31: Forgotten password utility (step 1)



Fig. 6.3.32: Forgotten password utility (step 2)

If user login name is correct the programme sends a mail (Fig. 6.3.32) to the user and generates another window (Fig. 6.3.33) again by asking the answer to password hint and user can set a new password.

প্যাসওয়ার্ড পুনরায় তৈরীকরন

ই-মেল পরীক্ষাকরন → পুনরায় প্যাসওয়ার্ড তৈরী করন → শেষ

দয়া করে নিম্নের বক্সের মধ্যে নতুন প্যাসওয়ার্ড লিখুন, এবং দৃঢ় হওয়ার জন্য দ্বিতীয় বক্সের মধ্যে পুনরায় লিখুন। এটি কমপক্ষে ৬টি অক্ষরের হতে হবে।

ই-মেলের ঠিকানা: kakoli@localhost

নতুন প্যাসওয়ার্ড:

সুনিশ্চিত হওয়ার জন্য
পুনরায় প্যাসওয়ার্ড
লিখুন:

প্যাসওয়ার্ড পুনরায় তৈরী করন

Fig. 6.3.33: Forgotten password utility (step 3)

পুনরায় প্যাসওয়ার্ড তৈরী করন

ই-মেল পরীক্ষাকরন → পুনরায় প্যাসওয়ার্ড তৈরী করন → শেষ

আপনার প্যাসওয়ার্ড পুনরায় তৈরী হয়েছে।

[ডিসপেন্স মূলপত্রে যান](#)

Fig. 6.3.34: Forgotten password utility (step 4)

H. Community and Sub-community Management

In any time addition, deletion and modification of Community and Sub-community (here সম্প্রদায় এবং অধীনস্থ সম্প্রদায়) is always possible and can be done through librarian interface. The process of creation and deletion of Community and Sub-community is shown here through three screen snapshots (Fig. 6.3.35 through Fig. 6.3.37).

নতুন সর্বোচ্চ স্তরের সম্প্রদায়ের জন্য মেটাডাটা সম্পাদন করুন

নাম:

সংক্ষিপ্ত বর্ণনা:

পরিচায়ক পাঠ্য (এইচ টি এম এল):

কপিরাইট পাঠ্য (সহজ পাঠ্য):

সংবাদ (এইচ টি এম এল):

নতুন বিজ্ঞাপনব্যাঞ্জ আপ লোড করুন:

সময়
[বিস্তৃত অনুসন্ধান](#)

খুঁজুন

- সমগ্র ডিস্কেস
 - সম্প্রদায়গুলি এবং সংগ্রহগুলি
 - প্রকাশিত তারিখ দ্বারা
 - লেখকগণ
 - আখ্যা
 - বিষয়গুলি

আমার খাতা

- আমার রণাঙ্গীগুলি
- লগ-আউট
- পরিচায়িকা
- দাখিলে কক্ষ

প্রশাসনিক

- এ্যাকসেস কন্ট্রোল
 - ব্যক্তি
 - গোষ্ঠী
 - ক্ষমতাদান
- রেজিস্ট্রী
 - মেটাডাটা
 - বিন্যাস
- ডালিকাতুজ বিষয়গুলি
- ডালিকাতুজ বিষয়গুলি তুলে নেওয়া
- কন্ট্রোল প্যানেল
- পরিসংখ্যান
- মেটাডাটা আমদানি

Fig. 6.3.35: Creation of Community

সম্প্রদায়ের জন্য মোছা সুনিশ্চিত করুন 43

আপনি কি সম্প্রদায় শিল্পকলা ও মানবিক অনুষদ বিভাগ মোছার জন্য প্রস্তুত? এইটি মোছা হবে:

- সম্প্রদায়ের অন্তর্ভুক্ত যেকোনো সংগ্রহ যেগুলি অন্য সম্প্রদায়ের অন্তর্ভুক্ত নয়
- এই সম্প্রদায়ের অন্তর্ভুক্ত যেকোনো তালিকাভুক্ত বিষয় এবং অসম্পূর্ণ দাখিলকরণ যেগুলি অন্য কোনো সংগ্রহের অন্তর্ভুক্ত নয়
- সেই তালিকাভুক্ত বিষয়গুলির বিষয়বস্তু
- সমস্ত সহযোগী স্বমতাপ্রাপ্ত নীতিগুলি

Fig. 6.3.36: Deletion of Community

নতুন অধীন্যস্ত সম্প্রদায়ের জন্য মেটাডাটা অন্তর্ভুক্ত করুন শিল্পকলা ও মানবিক অনুষদ বিভাগ

নাম:

সংক্ষিপ্ত বর্ণনা:

পরিচায়ক পাঠ্য (এইচ টি এম এল):

কপিরাইট পাঠ্য (সহজ পাঠ্য):

সংবাদ (এইচ টি এম এল):

নতুন বিজ্ঞাপনব্যাজ আপ লোড করুন:

[বিস্তৃত অনুসন্ধান](#)

খুঁজুন

- সমগ্র ডিস্কেস
 - সম্প্রদায়গুলি এবং সংগ্রহগুলি
 - প্রকাশিত তারিখ দ্বারা
 - লেখকগণ
 - আখ্যা
 - বিষয়গুলি

আমার খাতা

- আমার রণনীগুলি
- লগ-আউট
- পরিচাধিকা
- দাখিল করুন

প্রশাসনিক

- এ্যাকসেস কন্ট্রোল
 - ব্যক্তি
 - গোষ্ঠী
 - স্বমতাদান
- রেজিস্ট্রী
 - মেটাডাটা
 - বিন্যাস
- তালিকাভুক্ত বিষয়গুলি
- তালিকাভুক্ত বিষয়গুলি

Fig. 6.3.37: Creation of Sub-community

I. Collection Management

In the same way, Collection (here সংগ্রহ) can be created under any Community. Any time deletion and modification of Collection is possible and is shown in two screen snapshots (Fig. 6.3.38 & Fig. 6.3.39).

একটি নতুন সংগ্রহের জন্য মেটাডাটা চোকান বাংলা বিভাগ

নাম:

সংক্ষিপ্ত বনরী:

পরিচায়ক পাঠ্য (এইচ টি এম এল):

কপিরাইট পাঠ্য (সহজ পাঠ্য):

সংবাদ (এইচ টি এম এল):

লাইসেন্স:

উৎস:

নতুন বিজ্ঞাপনব্যাজ আপ লোড করুন:

Fig. 6.3.38: Creation of Collection

সংগ্রহের জন্য মোছা সুনিশ্চিত করুন 219

আপনি কি নিশ্চিত সংগ্রহ প্রকাশিত গবেষণাপত্র (গ্রন্থাগার ও তথ্য বিজ্ঞান বিভাগ) মোছার জন্য ? এইটি মোছা উচিত:

- ই সংগ্রহের অন্তর্ভুক্ত যেকোনো তালিকাভুক্ত বিষয় এবং অসম্পূর্ণ দাখিলকরণ যেগুলি অন্য কোনো সংগ্রহের অন্তর্ভুক্ত নয়
- এই সকল তালিকাভুক্ত বিষয়গুলির আধার
- সমস্ত সহযোগী ক্ষমতাপ্রাপ্ত নীতিগুলি

Fig. 6.3.39: Deletion of Collection

The next logical step is to perform various administrative operations (e.g. E-person selection, workflow management etc.) at the Collection level and can be done by clicking of appropriate button at the right hand side of each section (Fig. 6.3.40).

সংগ্রহ সম্পাদন করুন: প্রকাশিত গবেষণাপত্র (গ্রন্থাগার ও তথ্য বিজ্ঞান বিভাগ)

মেটাডাটা সম্পাদন করুন
দায়িত্ব আরোপিত করুন
সূচীর উৎস
তত্ত্বাবধায়ক করা

দায়িত্ব	সহযোগী গোষ্ঠী	
তত্ত্বাবধায়কগন	কেউ নয়	তৈরী করুন...
সংগ্রহের তত্ত্বাবধায়ক ঠিক করবেন কে বা কারা এই সংগ্রহে তালিকাভুক্ত বিষয়গুলি দাখিল করতে পারবেন, তালিকাভুক্ত বিষয়গুলির মেটাডাটা সম্পাদন করা (দাখিলকরনের পরে), এবং অন্য সংগ্রহের তালিকাভুক্ত বিষয়গুলি এই সংগ্রহে যোগ করতে পারবেন (যদি ওই সংগ্রহে তালিকাভুক্ত বিষয় দাখিল করার অধিকার থাকে)।		
গ্রন্থন/বর্জন ধাপ	কেউ নয়	তৈরী করুন...
এই ধাপের সঙ্গে যুক্ত ব্যক্তি আগত দাখিলটি গ্রহন অথবা অমনোনীত করতে পারেন। যদিও, তারা দাখিলটির মেটাডাটা সম্পাদন করতে পারবেন না।		
মেটাডাটা গ্রন্থন/বর্জন /সম্পাদন ধাপ	কেউ নয়	তৈরী করুন...
এই ধাপের সঙ্গে যুক্ত ব্যক্তি আগত দাখিলটির মেটাডাটা সম্পাদন করতে পারেন, এবং তারপর দাখিলটি গ্রহন অথবা অমনোনীত করতে পারেন।		
মেটাডাটা সম্পাদন ধাপ	কেউ নয়	তৈরী করুন...
এই ধাপের সঙ্গে যুক্ত ব্যক্তি আগত দাখিলটির মেটাডাটা সম্পাদন করতে পারেন, কিন্তু দাখিলটি অমনোনীত করতে পারবেন না।		
দাখিলকারীগন	কেউ নয়	তৈরী করুন...
ই-পার্সন এবং গোষ্ঠী যারা এই সংগ্রহে নতুন তালিকাভুক্ত বিষয় দাখিল করার অধিকারী।		
সহজাত পড়ার সুবিধা	আগত তালিকাভুক্ত বিষয়গুলি এবং বিটস্টীমগুলির জন্য সহজাত নাম বিহীন পড়ার সুবিধা ঠিক করা আছে।	নিষিদ্ধ...
ই-পার্সন এবং গোষ্ঠী যারা এই সংগ্রহে নতুন দাখিলাকৃত তালিকাভুক্ত বিষয় পড়ার অধিকারী। এই দায়িত্বের পরিবর্তন কিন্তু বর্তমান সম্পর্কীয় (retroactive) নয়। সিস্টেমের বিদ্যমান তালিকাভুক্ত বিষয়গুলি এখনও তাদের কাছে দৃশ্যমান হবে বিষয়গুলি যুক্ত হবার সময় যাদের পড়ার সুযোগ বা সুবিধা ছিল।		
স্বমতাপ্রাপ্ত নীতিগুলি সরাসরি সম্পাদন করুন।		

আগের জায়গায় ফিরে যান

Fig. 6.3.40: Collection Workflow Management

This window (Fig. 6.3.41) is supported by drop down menu lists from where E-person/Group can be chosen for different workflow and is shown in two screen snapshots (Fig. 6.3.42 & Fig. 6.3.43).

গোষ্ঠীর সম্পাদক:
COLLECTION_219_WORKFLOW_STEP_2 (id: 422)

এই গোষ্ঠীটি সংগ্রহের সঙ্গে যুক্ত আছে: [প্রকাশিত গবেষণাপত্র \(গ্রন্থাগার ও তথ্য বিজ্ঞান বিভাগ\)](#)

গোষ্ঠীর নাম পরিবর্তন করুন:

সদস্যদের অনুসন্ধান করুন যুক্ত করতে:

আই. ডি.	নাম	ই-মেল	
11	Subal Ch. Biswas	scb@localhost	<input type="button" value="যোগ করুন"/>
1	Bijan Kumar Roy	dspace@localhost	<input type="button" value="যোগ করুন"/>
8	Kakoli Roy	kakoli@localhost	<input type="button" value="যোগ করুন"/>
2	Tulu Roy	tulu@localhost	<input type="button" value="যোগ করুন"/>
13	বিজন কুমার রায়	bijan@localhost	<input type="button" value="যোগ করুন"/>

Fig. 6.3.41: List of E-persons or Group

আই. ডি.	নাম	ই-মেল	
11	Subal Ch. Biswas	scb@localhost	<input type="button" value="যোগ করুন"/>
1	Bijan Kumar Roy	dspace@localhost	<input type="button" value="যোগ করুন"/>
8	Kakoli Roy	kakoli@localhost	<input type="button" value="যোগ করুন"/>
2	Tulu Roy	tulu@localhost	<input type="button" value="যোগ করুন"/>
13	বিজন কুমার রায়	bijan@localhost	<input type="button" value="যোগ করুন"/> অমীমাংসিত

সদস্যগণ

আই. ডি.	নাম	ই-মেল	
13	বিজন কুমার রায় [অমীমাংসিত]	bijan@localhost	<input type="button" value="সরিখে দিন"/>

বার্তা, অমীমাংসিত রাখার পরিবর্তনগুলি সংরক্ষিত হবে না যতক্ষন না সংরক্ষণ করুন বোতাম চিপবেন

Fig. 6.3.42: Selection of New E-person



Fig. 6.3.43: Display of New E-person for Collection Workflow

J. Submission Process of BURA

BURA allows distributed submission of resources from any work station at anytime. The system allows remote submission of resources through creation of membership. The submission process in BURA has been discussed in details in section 6.1.16 of chapter 6. Submitter can start new submission by clicking of ‘Submission’ (here দাখিল করুন). The submission process is demonstrated here through ten screen snapshots (Fig. 6.3.44 through Fig. 6.3.53). The programme generates a small window (Fig. 6.3.44) which is supported by drop down menu lists allows submitter selecting appropriate Collection. The node in ‘green’ indicates the current screen of the seven (7) screens.

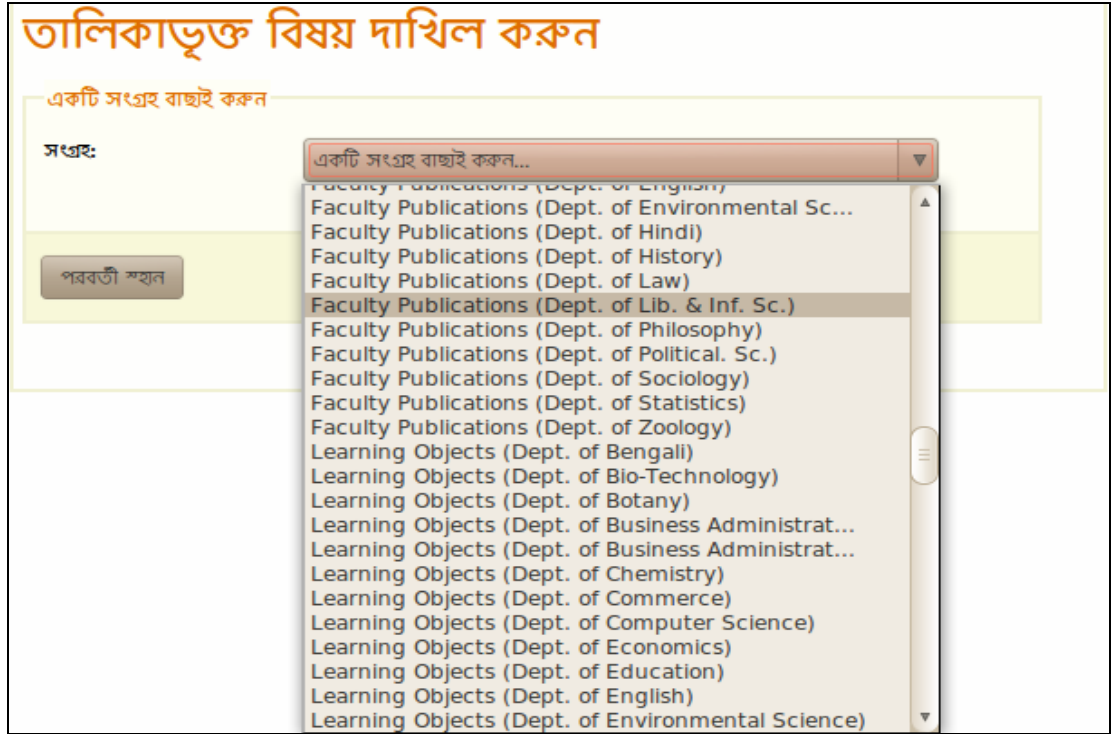


Fig. 6.3.44: Submission Process Step 1

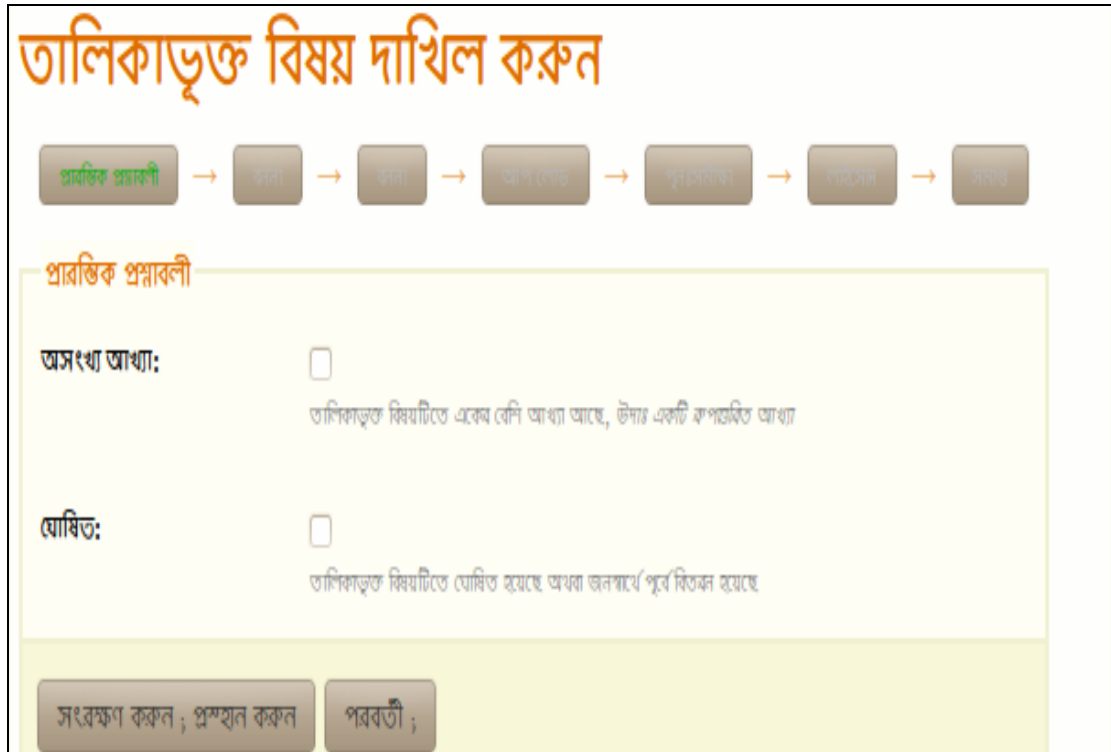


Fig. 6.3.45: Submission Process Step 2

The windows (Fig. 6.3.46 & Fig. 6.3.47) are displayed and submitter can enter required metadata in specified fields one-by-one.

তালিকাভুক্ত বিষয় দাখিল করুন

প্রারম্ভিক প্রদর্শনী → **বর্ণনা** → বর্ণনা → আপলোড → পুনঃসমীক্ষা → লাইসেন্স → সমাপ্ত

তালিকাভুক্ত বিষয়টিকে বর্ণনা করুন

লেখক:
শেষ নাম, উদাঃ স্মিথ

প্রথম নাম + "জুনিয়ার", উদাঃ জোনাস জুনিয়ার
এই তালিকাভুক্ত বিষয়টির লেখকের নাম বক্সের মধ্যে লিখুন।

আখ্যা:
তালিকাভুক্ত বিষয়টির মুখ্য আখ্যাটি লিখুন।

গ্রন্থমালা/প্রতিবেদন সংখ্যা:
গ্রন্থমালার নাম
পরিসংখ্যান অথবা পেপার নং
সম্প্রদায় কর্তৃক প্রদত্ত তালিকাভুক্ত বিষয়টির গ্রন্থমালা এবং সংখ্যা লিখুন।

সনাক্তিকরণ:
তালিকাভুক্ত বিষয়টির যদি কোন সাংকেতিক নাম্বার বা কোড থাকে, দয়া করে উহার প্রকার এবং আসল নাম্বার বা কোড লিখুন।

আকার:

তালিকাভুক্ত বিষয়টির আকার বাছাই করুন। এই তালিকায় একাধিক আকার বাছাইয়ের জন্য আপনি "সি.টি.আর.এল" অথবা "সিফট" কি ব্যবহার করতে পারেন।

ভাষা:
তালিকাভুক্ত বিষয়টির ভাষা বাছাই করুন। যদি ভাষাটি উক্ত তালিকায় দৃশ্যমান না হয়, দয়া করে 'অন্যান্য' বাছাই করুন। যদি বিষয়টির কোন ভাষা না থাকে (উদাঃ যদি বিষয়টি কোন ডাটাসেট অথবা ছবি সংক্রান্ত হয়), দয়া করে 'এন/এ' বাছাই করুন।

Fig. 6.3.46: Submission Process Step 3

তালিকাভুক্ত বিষয় দাখিল করুন

প্রারম্ভিক প্রমাণবলী → বর্ণনা → বর্ণনা → আপ লোড → পুনঃসমীক্ষা → সমাপ্ত

তালিকাভুক্ত বিষয়টিকে বর্ণনা করুন

বিষয়টির মূলতত্ত্ব: Add

বিষয়টির মূলতত্ত্ব অথবা ফ্রেঞ্জ লিখুন।

বাংলা সাহিত্য

Remove selected

সংক্ষিপ্তসার:

মানস্বত্বিকতার অনোকে রবীন্দ্রনাথ চাকুরের ঘরে তজনীয় তা ।

বিষয়টির সংক্ষিপ্তসার লিখুন।

আয়োজক:

ইউ জি মি

আয়োজক এরং/অথবা ফণ্ডিং কোডের নাম লিখুন।

বর্ণনা:

কে কে দায় কেনেজ অয়ে তজিত জাতীয় অনোচনাচক্র (মার্চ ১০-১১, ২০১১) । বিষয় : মানস্বত্বিকতার অনোকে রবীন্দ্রনাথ ।

অন্য যে কোন বর্ণনা অথবা মতামত লিখতে পারেন ।

পূর্ববর্তী সংরক্ষণ করুন ; প্রস্থান করুন পরবর্তী ;

Fig. 6.3.47: Submission Process Step 4

The next logical step is uploading file(s) and can be done through 'Browse' button (Fig. 6.3.48). Again, the system displays all the metadata fields along with the file(s) and submitter can check and verify it clicking on appropriate button of the particular section (Fig. 6.3.49).

নথিগুলি আপ লোড করা

নথি:

দয়া করে তালিকাভুক্ত বিষয়ের নথিটির পুরো ঠিকানা দিন। আপনি যদি ব্রাউজ (Browse) নির্বাচন করেন..., তখন নতুন করে নথি নির্বাচন করতে পারবেন।

নথির বর্ণনা:

এইভাবে, নথিটির সংক্ষিপ্ত বর্ণনা দেবেন, উদাঃ "নুখা নথি", অথবা "পরীক্ষামূলক ডাটা মিডিং".

নথি আপ লোড করুন

প্রাথমিক	নথি	মাপ	বর্ণনা	আকার	
<input type="radio"/>	<input type="checkbox"/> pg1.jpg	1747771 bytes	অজানা	image/jpeg (সমর্থিত)	<input type="button" value="সম্পাদনা"/>

নথি পরীক্ষাকরন: MD5:e6f748c01bfa01d38ce0e302c8e27f3a

Fig. 6.3.48: Submission Process Step 5

মাখিলকৃত বিষয়ের পুনঃসমীক্ষা করা

প্রারম্ভিক প্রস্নাবলী

অসংখ্য আখ্যা:

যোষিত:

তালিকাভুক্ত বিষয়টিকে বর্ণনা করুন

Authors:

Title:

Type:

Language:

তালিকাভুক্ত বিষয়টিকে বর্ণনা করুন

Subject Keywords:

Subject Keywords:

Abstract:

Sponsors:

Description:

নথিগুলি আপ লোড করা

[pg1.jpg](#) - JPEG (জাত)

Fig. 6.3.49: Submission Process Step 6

To make the submission process complete, granting license is mandatory and it can be done clicking on ‘I grant the License’ button (here আমি লাইসেন্সটি ছাড় দিচ্ছি) (Fig. 6.3.50).

তালিকাভুক্ত বিষয় দাখিল করুন

প্রাথমিক পরামর্শী → বর্ণনা → বর্ণনা → আপ লোড → পুনঃসমীক্ষা → **লাইসেন্স** →

বিতরণের লাইসেন্স

একটি শেষ ধাপ আছে: বিশ্ব জুড়ে ডিস্ট্রিবিউট আপনাদের দাখিলকৃত বিষয়টিকে পুনরায় তৈরী করার, ভাষান্তর করার এবং বিতরণ করার সুযোগের জন্য আপনাকে নিচের শর্তগুলির সঙ্গে সন্মত হতে হবে।

সঠিক মানের বিতরণের লাইসেন্সকে ছাড় দিতে হলে বাছাই করুন আমি লাইসেন্সটিকে ছাড় দিচ্ছি; এবং তারপর ক্লিক করুন দাখিলকরণ সম্পূর্ণ।

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এই লাইসেন্স সংক্রান্ত জিজ্ঞাসা থাকলে দয়া করে পদ্ধতির তত্ত্বাবধায়কদের সঙ্গে যোগাযোগ করুন।

বিতরণের লাইসেন্স: আমি লাইসেন্সটি ছাড় দিচ্ছি

পূর্ববর্তী | সংরক্ষণ করুন, প্রস্থান করুন | **দাখিল করা সম্পূর্ণ হয়েছে**

Fig. 6.3.50: Submission Process Step 7

দাখিলকরণ সম্পূর্ণ

আপনার দাখিলকৃত বিষয়টি এখন এই সংগ্রহের পুনঃসমীক্ষা পদ্ধতির মধ্য দিয়ে যাচ্ছে। আপনার দাখিলকৃত বিষয়টি সংগ্রহে যুক্ত হলে আপনি শীঘ্রই ই-মেল বিজ্ঞপ্তি পাবেন, অথবা আপনার দাখিলকরণে কোনো সমস্যা হলে। আবার আপনি দাখিলকৃত বিষয়টির অবস্থা দেখে নিতে পারেন দাখিলকরণ পাতায় গিয়ে।

[দাখিলকরণ পাতায় যান](#)

আর একটি তালিকাভুক্ত বিষয় দাখিল করুন

Fig. 6.3.51: Submission Process Step 8

Once the submission is over, item can be sent to the concerned E-person(s) for final approval for inclusion of the item into BURA and is shown here in two screen snapshots (Fig. 6.3.52 & Fig. 6.3.53).

দাখিল করুন এবং কর্মপ্রবাহের কার্যকলাপ

কর্মপ্রবাহের কার্যকলাপ

তালিকাভুক্ত বিষয়টির কার্যকলাপের সংগ্রহশালায় অন্তর্ভুক্তির পূর্বে অনুমোদন প্রয়োজন। এই কর্মপ্রবাহে দুটি কার্যকলাপ আছে, কার্যকলাপ যেটা আপনি গ্রহন করেছেন এবং আরেকটি কার্যকলাপ যেটা এখনো কেউ গ্রহন করেনি।

আপনার জন্য কার্যকলাপ

কার্যকলাপ	তালিকাভুক্ত বিষয়	সংগ্রহ	দাখিলকারী
আপনার উপর আরোপিত কোনো কার্যকলাপ নেই			

এই ক্ষেত্রের কার্যকলাপ

কার্যকলাপ	তালিকাভুক্ত বিষয়	সংগ্রহ	দাখিলকারী
<input type="checkbox"/>	সম্পাদকের পর্যবেক্ষণের জন্য অপেক্ষা করা হচ্ছে	কেন রবীন্দ্রনাথ ?	Faculty Publications (Dept. of Lib. & Inf. Sc.)
<input type="button" value="বাছাইকৃত কার্যকলাপ গ্রহন করুন"/>			

দাখিলকরণ

আপনি পারেন [নতুন দাখিল শুরু করুন](#)। এই দাখিলকরণ পদ্ধতিটি তালিকাভুক্ত বিষয় এবং আপ লোড নথির বর্ণনা অন্তর্ভুক্ত করে। একটি সম্প্রদায়/সংগ্রহ তার নিজের মত দাখিলকরণ নীতিগুলি রচনা করতে পারে।

দাখিলকৃত বিষয় পুনঃসমীক্ষা করা

এইগুলি আপনার পূর্ন দাখিলকৃত বিষয়, যেগুলি বর্তমানে সংগ্রহ তত্ত্বাবধায়ক দ্বারা পুনঃসমীক্ষা করা হচ্ছে।

আখ্যা	সংগ্রহ	অবস্থা
কেন রবীন্দ্রনাথ ?	Faculty Publications (Dept. of Lib. & Inf. Sc.)	সম্পাদকের পর্যবেক্ষণের জন্য অপেক্ষা করা হচ্ছে

Fig. 6.3.52: Submission Process Step 9

The window (Fig. 6.3.52) displays four options and concerned E-person can pick up anything by clicking on it. And finally button ‘অনুমোদিত তালিকাভুক্ত বিষয়’ can be clicked to have the item to the archive.

তালিকাভুক্ত বিষয় দাখিল করুন

আখ্যা:	কেন রবীন্দ্রনাথ ?
লেখক:	চক্রবর্তী, বিকাশ
সংক্ষিপ্তসার:	সাম্প্রতিকতার আলোকে রবীন্দ্রনাথ ঠাকুরের প্রয়োজনীয়তা ।
বর্ণনা:	জাতীয় আলোচনাচক্র (মার্চ ১০-১১, ২০১১) । বিষয় : সাম্প্রতিকতার আলোকে রবীন্দ্রনাথ । কে কে দাস কলেজ ।

এই তালিকাভুক্ত বিষয়ের অন্তর্ভুক্ত নথিপত্র

নথিপত্র	আয়তন	বিন্যাস	দেখুন
pg1.jpg	1.666Mb	জেপিইজি ইমেজ	দেখুন/খুলুন

সমগ্র বিষয়বস্তু দেখুন

এই কর্তব্যের আপনার করণীয় কার্য:

যদি আপনি তালিকাভুক্ত বিষয়টির পুনঃসমীক্ষার পর সংগ্রহে যোগ করতে চান, তাহলে বাছাই করুন "অনুমোদিত"।

[অনুমোদিত তালিকাভুক্ত বিষয়](#)

যদি আপনি তালিকাভুক্ত বিষয়টির পুনঃসমীক্ষা করেন এবং দেখেন সংগ্রহে যোগ করার উপযোগী নয়, তাহলে বাছাই করুন "অমনোনীত"। এরপর আপনি জিজ্ঞাসিত হবেন যে ম্যাসেজের মাধ্যমে জানান কেন তালিকাভুক্ত বিষয়টি উপযোগী নয়, এবং দাখিলকারী কিছু পরিবর্তন করবে কিনা এবং পুনরায় দাখিল করবে কিনা।

[অমনোনীত তালিকাভুক্ত বিষয়](#)

যদি আপনি তালিকাভুক্ত বিষয়টির মেটাডাটা পরিবর্তন করতে চান তাহলে এই সুবিধাটি বাছাই করুন

[মেটাডাটা সম্পাদন করুন](#)

স্কেএ-র কর্তব্যগুলিতে ফিরে আসুন যাতে অন্য ব্যবহারকারী কর্তব্যগুলি করতে পারে ।

[স্কেএ-র কর্তব্যগুলিতে ফিরে আসুন](#)

বাতিল করুন

Fig. 6.3.53: Submission Process Step 10

K. Item Management

BURA software framework allows addition, deletion, withdrawal and removal of submitted items (তালিকাভুক্ত বিষয়) and all the operations can be done clicking on appropriate button of the subsequent window (Fig. 6.3.54). A number of Bitstreams

can be added and side by side existing Bitstreams already in the system can also be deleted and is shown in three screen snapshots (Fig. 6.3.55 through Fig. 6.3.57).

Fig. 6.3.54: Item Management

Fig. 6.3.55: Addition of New Bitstreams

ঘোষণা

The new bitstream was successfully uploaded.

তালিকাভুক্ত বিষয়গুলি সম্পাদন করুন

তালিকাভুক্ত বিষয়ের অবস্থা তালিকাভুক্ত বিষয়ের বিটস্ট্রীমগুলি তালিকাভুক্ত বিষয়ের মেটাডাটা তালিকাভুক্ত বিষয় দেখুন

তত্ত্বাবধায়ক করা বিটস্ট্রীমগুলি

নাম	বর্ণনা	বিন্যাস	দেখুন
বাগেল (Bundle): ORIGINAL			
<input type="checkbox"/>	banglaP v b.pdf	Adobe PDF	[দেখুন]
<input type="checkbox"/>	pg2.jpg	JPEG	[দেখুন]
বাগেল (Bundle): LICENSE			
<input type="checkbox"/>	license.txt	License	[দেখুন]

[একটি নতুন বিটস্ট্রীম আপ লোড করুন](#)

Fig. 6.3.56: New Bitstreams Added

ঘোষণা

The selected bitstreams have been deleted.

তালিকাভুক্ত বিষয়গুলি সম্পাদন করুন

তালিকাভুক্ত বিষয়ের অবস্থা তালিকাভুক্ত বিষয়ের বিটস্ট্রীমগুলি তালিকাভুক্ত বিষয়ের মেটাডাটা তালিকাভুক্ত বিষয় দেখুন

তত্ত্বাবধায়ক করা বিটস্ট্রীমগুলি

নাম	বর্ণনা	বিন্যাস	দেখুন
বাগেল (Bundle): ORIGINAL			
<input type="checkbox"/>	banglaP v b.pdf	Adobe PDF	[দেখুন]
বাগেল (Bundle): LICENSE			
<input type="checkbox"/>	license.txt	License	[দেখুন]

[একটি নতুন বিটস্ট্রীম আপ লোড করুন](#)

Fig. 6.3.57: Bitstreams Deleted

The window (Fig. 6.3.58) is displayed and submitted item can be edited and new metadata field can be incorporated by clicking on the appropriate button and finally displays the item in details (Fig. 6.3.59).

তালিকাভুক্ত বিষয়ের অবস্থা | তালিকাভুক্ত বিষয়ের বিটস্ট্রীমগুলি | তালিকাভুক্ত বিষয়ের মেটাডাটা | তালিকাভুক্ত বিষয় দেখুন

তত্ত্বাবধায়ক করা | **নতুন মেটাডাটা যোগ করুন**

নাম:

dc.contributor.advisor

মূল্য:

ভাষা

নতুন মেটাডাটা যোগ করুন

দৃষ্টি আকর্ষণ: এই পরিবর্তনগুলি কোনভাবে বৈধ নয়। আপনি তথ্য সঠিক আকারে লিপিবদ্ধ করার অধিকারী। আপনি যদি আকার সম্ভবে নিশ্চিত না হন, দয়া করে আকারের কোন পরিবর্তন করবেন না।

সাম্প্রতিক তথ্য | আগের জায়গায় ফিরে যান

মেটাডাটা

সরিয়ে দিন	নাম	মূল্য	ভাষা
		বঙ্গ, বাদন	
<input type="checkbox"/>	dc. subject	বাংলা সাহিত্য	en_US
<input type="checkbox"/>	dc. subject	পাবনিকোন	en_US
<input type="checkbox"/>	dc. subject	বাংলা	en_US
<input type="checkbox"/>	dc. subject	গবেষণাপত্র	en_US
<input type="checkbox"/>	dc. title	বাংলা প্রকাশনা ও তথ্য প্রকাশনা	en_US
<input type="checkbox"/>	dc. type	Article	en_US

সাম্প্রতিক তথ্য | আগের জায়গায় ফিরে যান

Fig. 6.3.58: Metadata Addition

তালিকাভুক্ত বিষয়গুলি সম্পাদন করুন

[তালিকাভুক্ত বিষয়ের অবস্থা](#) |
 [তালিকাভুক্ত বিষয়ের বিটস্ট্রীমগুলি](#) |
 [তালিকাভুক্ত বিষয়ের মেটাডাটা](#) |
 [তালিকাভুক্ত বিষয় দেখুন](#)

[তত্ত্বাবধায়ক করা](#) |
 [লিপিবদ্ধ সমগ্র বিষয়বস্তু দেখানো হবে](#)

আখ্যা:	বাংলা প্রকাশনা ও তথ্য প্রকাশনা
লেখক:	বসু, বাদল
সংক্ষিপ্তসার:	বাংলা প্রকাশনা জগতে তথ্যপ্রযুক্তির ভূমিকা।
বর্ণনা:	বিশ্বভারতী, ১৪১৩, প্রথম সংখ্যা, বৈশাখ
ইউনিফর্ম রিসোর্স লোকেটর:	http://hdl.handle.net/123456789/512
তারিখ:	2013-05-15

এই তালিকাভুক্ত বিষয়ের অন্তর্ভুক্ত নথিপত্র

নথিপত্র	আয়তন	বিন্যাস	দেখুন
banglaP v b.pdf	72.61Kb	PDF	দেখুন/খুলুন

এই তালিকাভুক্ত বিষয়টি নিম্নলিখিত সংগ্রহগুলির মধ্যে দৃশ্যমান হয়েছে

- [Faculty Publications \(Dept. of Bengali\)](#)

[লিপিবদ্ধ সমগ্র বিষয়বস্তু দেখানো হবে](#)

Fig. 6.3.59: Full Item Displayed

If an item is wrongly entered to a Collection, it can be moved to the desired destination (Collection). The system displays a window (Fig. 6.3.60) supported by drop down menu list from where repository manager can select appropriate Collection where item is to be moved.

সরিয়ে দিন: 123456789/512

সংগ্রহ: Faculty Publications (Dept. of Lib. & Inf. Sc.) ▼

সংগ্রহ বাছাই করুন যেখানে আপনি পছন্দমতো এই তালিকাভুক্ত বিষয়টি সরিয়ে নিয়ে যেতে চান।

সহজাত নীতিগুলি:

এই সংগ্রহের সহজাত নীতিগুলি

সরিয়ে দিন
বাতিল করুন

Fig. 6.3.60: Item Moved to another Collection

Bitstreams and Bundles policy can be changed and system manager can add, edit or restated existing policy clicking on the appropriate button on the right side of the each section (Fig. 6.3.61).

নীতিগুলি তালিকাভুক্ত বিষয়ের 123456789/512

(আই.ডি=322)

এই সম্পাদকের (editor) সাহায্যে তালিকাভুক্ত বিষয়ের নীতিগুলি দেখতে এবং পরিবর্তন করতে পারবেন, তথাপি তালিকাভুক্ত বিষয়টির উপাদানের নীতিগুলি পরিবর্তন করতে পারবেন : বাণ্ডেল (Bundles) এবং বিটস্ট্রীম (bitstreams)। সংক্ষেপে , একটি তালিকাভুক্ত বিষয় হল বাণ্ডেল (Bundles) এর সমষ্টি, এবং বাণ্ডেল (Bundles) হল বিটস্ট্রীম (bitstreams) এর সমষ্টি। কন্টেনারগুলোর (containers) সচরাচর যোগ করা/ সরিয়েদেওয়া/ পড়ার/লেখার নীতি থাকে, যেখানে বিটস্ট্রীম (bitstreams) এর কেবলমাত্র পড়ার/লেখার নীতি আছে।

আপনি অতিরিক্ত বাণ্ডেল (Bundles) এবং বিটস্ট্রীম (bitstreams) দেখবেন প্রত্যেকটি তালিকাভুক্ত বিষয়ের যেটা বিষয়টির লাইসেন্স বহন করছে।

আই.ডি	কাজকর্ম	গোষ্ঠী
তালিকাভুক্ত বিষয়ের নীতিগুলি একটি নতুন তালিকাভুক্ত বিষয়ের নীতি যোগ করুন		
<input type="checkbox"/> 14173	READ	Anonymous [সম্পাদন করুন]
বাণ্ডেল (Bundle) এর নীতিগুলি ORIGINAL (530) একটি নতুন বাণ্ডেল (Bundle) নীতি যোগ করুন		
<input type="checkbox"/> 14175	READ	Anonymous [সম্পাদন করুন]
বিটস্ট্রীম banglaP v b.pdf (539) একটি নতুন বিটস্ট্রীমের নীতি যোগ করুন		
<input type="checkbox"/> 14174	READ	Anonymous [সম্পাদন করুন]
বাণ্ডেল (Bundle) এর নীতিগুলি LICENSE (531) একটি নতুন বাণ্ডেল (Bundle) নীতি যোগ করুন		
<input type="checkbox"/> 14177	READ	Anonymous [সম্পাদন করুন]
বিটস্ট্রীম license.txt (540) একটি নতুন বিটস্ট্রীমের নীতি যোগ করুন		
<input type="checkbox"/> 14176	READ	Anonymous [সম্পাদন করুন]

বাছাইগুলি মুছুন
আগের জায়গায় ফিরে যান

Fig. 6.3.61: Item Policy

In any time, item can be withdrawn, removed and reinstated and is shown in three screen snapshots (Fig. 6.3.62 through Fig. 6.3.64).

নথি বদলান: 123456789/512

আপনি কি এই নথিটিকে সংরক্ষন থেকে তুলে নিতে চান?

ক্ষেত্র	মূল্য	ভাষা
dc.contributor.advisor		
dc.contributor.advisor		
dc.contributor.author	বসু, বাদল	
dc.date.accessioned	2013-05-15T15:23:54Z	
dc.date.available	2013-05-15T15:23:54Z	
dc.date.issued	2013-05-15	
dc.description	বিশ্বভারতী, ১৪১৩, প্রথম সংখ্যা, কৈশাখ	en_US
dc.description.abstract	বাংলা প্রকাশনা জগতে তথ্যপ্রযুক্তির ভূমিকা।	en_US
dc.description.sponsorship	বিশ্বভারতী	en_US
dc.identifier.uri	http://hdl.handle.net/123456789/512	
dc.language.iso	other	en_US
dc.subject	বাংলা সাহিত্য	en_US
dc.subject	পাবলিকেশান	en_US
dc.subject	বাংলা	en_US
dc.subject	গবেষণাপত্র	en_US
dc.title	বাংলা প্রকাশনা ও তথ্য প্রকাশনা	en_US
dc.type	Article	en_US

Fig. 6.3.62: Withdrawal of Item

আপনি কি নিশ্চিতভাবে এই নথিটি সম্পূর্ণভাবে মুছে চান? সতর্কতা: সতর্কতা: বর্তমানে, নথিটির কোন প্রমাণ্য (tombstone) রাখা হবে না।

ক্ষেত্র	মূল্য	ভাষা
dc.contributor.advisor		
dc.contributor.advisor		
dc.contributor.author	বসু, বাদল	
dc.date.accessioned	2013-05-15T15:23:54Z	
dc.date.available	2013-05-15T15:23:54Z	
dc.date.issued	2013-05-15	
dc.description	বিশ্বভারতী, ১৪১৩, প্রথম সংখ্যা, কৈশাখ	en_US
dc.description	বাংলা প্রকাশনা জগতে তথ্যপ্রযুক্তির ভূমিকা।	en_US
dc.subject	বাংলা	en_US
dc.subject	গবেষণাপত্র	en_US
dc.title	বাংলা প্রকাশনা ও তথ্য প্রকাশনা	en_US
dc.type	Article	en_US

মুছে দিন বাতিল করুন

Fig. 6.3.63: Removal of Item

আপনি কি এই নথিটিকে সংরক্ষণের জন্য পুনর্বহাল করতে চান?

ক্ষেত্র	মূল্য	ভাষা
dc.contributor.advisor		
dc.contributor.advisor		
dc.contributor.author	বসু, বাদল	
dc.date.accessioned	2013-05-15T15:23:54Z	
dc.date.available	2013-05-15T15:23:54Z	
dc.date.issued	2013-05-15	
dc.description	বিশ্বভারতী, ১৪১৩, প্রথম সংখ্যা, কৈশাখ	en_US
dc.description	বাংলা প্রকাশনা জগতে তথ্যপ্রযুক্তির ভূমিকা।	en_US
dc.subject	বাংলা	en_US
dc.subject	গবেষণাপত্র	en_US
dc.title	বাংলা প্রকাশনা ও তথ্য প্রকাশনা	en_US
dc.type	Article	en_US

পুনর্বহাল করা বাতিল করুন

Fig. 6.3.64: Item Reinstated

L. Administrative Policy Management

BURA software framework allows managing policies related to Community, Collection or Item. The new policy can be added, edited or modified by selecting desired field. The entire process of managing administrative policy (প্রশাসনিক ক্ষমতাপ্রাপ্ত নীতি) is shown here through five screen snapshots (Fig. 6.3.65 though Fig. 6.3.69).

প্রশাসনিক ক্ষমতাপ্রাপ্ত নীতিগুলি

তালিকাভুক্ত বিষয়ের ক্ষমতাদান

একটি তালিকাভুক্ত বিষয়ের
দিকে তাকান: খুঁজে পান

অ্যাডভান্সড ক্ষমতাপ্রাপ্ত যন্ত্র: [এখানে ক্লিক করুন তালিকাভুক্ত বিষয়টির ওয়াইল্ডকার্ড \(wildcard\) নীতির প্রশাসনিক যন্ত্রে \(tool\) যাবার জন্য।](#)

সম্প্রদায়/সংগ্রহের ক্ষমতাদান

একটি সম্প্রদায়/সংগ্রহে ক্লিক করুন তার নীতিগুলির সম্পাদনের জন্য।

- [Faculty of Arts and Humanities](#)
 - [Department of Bengali](#)
 - [Dissertations and Theses \(Dept. of Bengali\)](#)
 - [Extension Services and Departmental Products \(Dept. of Bengali\)](#)
 - [Faculty Publications \(Dept. of Bengali\)](#)
 - [Learning Objects \(Dept. of Bengali\)](#)
 - [Projects and Reports \(Dept. of Bengali\)](#)
 - [Question Papers \(Dept. of Bengali\)](#)
 - [Department of Business Administration](#)
 - [Dissertations and Theses \(Dept. of Business Administration\)](#)
 - [Extension Services and Departmental Products \(Dept. of Business Administration\)](#)

Fig. 6.3.65: Administrative Policy 1

সংগ্রহের জন্য নীতিগুলি "Faculty Publications (Dept. of Bengali)"
(123456789/43, আই.ডি: 16)

এখানে ক্লিক করুন একটি নতুন নীতি যোগ করার জন্য।

আই.ডি	কাজকর্ম	গোষ্ঠী
<input type="checkbox"/> 325	ADD	COLLECTION_16_WORKFLOW_STEP_2 [সম্পাদন করুন]
<input type="checkbox"/> 324	ADD	COLLECTION_16_SUBMIT [সম্পাদন করুন]
<input type="checkbox"/> 323	DEFAULT_BITSTREAM_READ	Anonymous [সম্পাদন করুন]
<input type="checkbox"/> 322	DEFAULT_ITEM_READ	Anonymous [সম্পাদন করুন]
<input type="checkbox"/> 321	READ	Anonymous [সম্পাদন করুন]

বাছাইগুলি মুছুন আগের জায়গায় ফিরে যান

Fig. 6.3.66: Administrative Policy 2

রচনা করুন নতুন নীতি COLLECTION 16

কাজকর্ম বাছাই করুন:

- READ
- WRITE
- ADD
- REMOVE
- DEFAULT_BITSTREAM_READ
- DEFAULT_ITEM_READ
- ADMIN

একটি গোষ্ঠী বাছাই করুন:

Administrator
 Anonymous
 COLLECTION_100_SUBMIT
 COLLECTION_100_WORKFLOW_STEP_2
 COLLECTION_101_SUBMIT

একটি গোষ্ঠীর জন্য অনুসন্ধান করুন:

Fig. 6.3.67: Administrative Policy 3

সম্পাদন করুন নীতি 325 for COLLECTION 16

কাজকর্ম বাছাই করুন:

READ
 WRITE
 ADD
 REMOVE
 DEFAULT_BITSTREAM_READ
 DEFAULT_ITEM_READ
 ADMIN

একটি গোষ্ঠী বাছাই করুন:

COLLECTION_168_WORKFLOW_STEP_2
 COLLECTION_169_SUBMIT
 COLLECTION_169_WORKFLOW_STEP_2
 COLLECTION_16_SUBMIT
 COLLECTION_16_WORKFLOW_STEP_2

একটি গোষ্ঠীর জন্য অনুসন্ধান করুন:

Fig. 6.3.68: Administrative Policy 4

গোষ্ঠীর সম্পাদক:

COLLECTION_16_WORKFLOW_STEP_2 (id: 31)

এই গোষ্ঠীটি সংগ্রহের সঙ্গে যুক্ত আছে: [Faculty Publications \(Dept. of Bengali\)](#)

গোষ্ঠীর নাম পরিবর্তন করুন:

সদস্যদের অনুসন্ধান করুন যুক্ত করতে:

সদস্যগণ

আই. ডি.	নাম	ই-মেল	
1	Bijan Kumar Roy	dspace@localhost	<input type="button" value="সরিয দিন"/>
2	Tulu Roy	tulu@localhost	<input type="button" value="সরিয দিন"/>

Fig. 6.3.69: Administrative Policy 5

6.4. Federated Search

Repository should have provision or support for the creation of metadata at the point of contribution or submission, and assurance that the metadata will be available to search engines (within the repository and externally) and/or harvesters. Here in BURA, metadata can be created by two ways – (i) by submitter at the time of submission or (ii) by librarian. Repository must have mechanism of harvesting metadata along with full text from different OAI-PMH compliant repositories worldwide. BURA allows metadata export from OAI-PMH compatible repositories via protocols like OAI/PMH (version 2.0). This software framework allows user browsing and searching a specific repository or all repositories harvested. It may eventually make it much simpler to replicate and redeposit contents in multiple repositories. The process of metadata harvesting from selected OAI-PMH compliant repositories is shown here through nine different screen snapshots (Fig. 6.4 through Fig. 6.4.8).

The system allows browsing repository(ies) and is demonstrated through three screen snapshots (Fig. 6.4 through Fig. 6.4.2).



Fig. 6.4: Browsing Repository for Metadata Harvesting

Home > Browse > E-LIS repository > **Records**

Records

E-LIS repository

[VIEW ARCHIVE INFO](#)

[BY TITLE](#) | [BY AUTHOR](#) | [BY REPOSITORY](#)

- » **La alfabetización informacional desde una perspectiva global: el desastre agudiza...**
Byrne, Alex
2013-05-19
[VIEW RECORD](#) | [VIEW ORIGINAL](#)
- » **DL: nuove dimensioni informative e nuovi linguaggi**
Canali, Daniela
2013-05-19
[VIEW RECORD](#) | [VIEW ORIGINAL](#)
- » **ORFEO: un software di gestione del servizio reference e uno strumento per condividere...**
Della Porta, Carola; Missana, Michela
2013-05-19
[VIEW RECORD](#) | [VIEW ORIGINAL](#)
- » **Management of, Knowledge, Information and Organizational Learning in University Libraries**
Ahumada Figueroa, Luis; Bustos-Gonzalez, Atilio
2013-05-19
[VIEW RECORD](#) | [VIEW ORIGINAL](#)
- » **BLOG Searching for Competitive Intelligence, Brand Image, and Reputation Management**
Pikas, Christina K.
2013-05-19
[VIEW RECORD](#) | [VIEW ORIGINAL](#)
- » **Od Doliny Krzemowej do BIBLIOPOLIS. Mikroklastery bibliotek miasta Poznania gromadzących...**
Andruszko, Hanna; Lamberti, Maria
2009-03-07
[VIEW RECORD](#) | [VIEW ORIGINAL](#)
- » **Institutional Repository saber.ula.ve: A testimonial perspective**

Fig. 6.4.1: Display of Results (Browsing)

Home > Browse > E-LIS repository > **Record Details**

Record Details

Management of, Knowledge, Information and Organizational Learning in University Libraries

E-LIS repository
[VIEW ARCHIVE INFO](#)

FIELD	VALUE
Title	Management of, Knowledge, Information and Organizational Learning in University Libraries
Creator	Ahumada Figueroa, Luis Bustos-Gonzalez, Atilio
Subject	ID. Knowledge representation.
Description	The dynamic advancement of technological development and the importance of information and knowledge in modern- day society have determined that the principal competitive advantage of an organization is the capacity to manage these resources adequately. The abilities and knowledge that workers are capable of developing are transformed into a resource that modern organizations value in a growing way. Educational organizations, especially universities, must take advantage of their competitive resources. That is to say, they must know how to make intensive use of their knowledge in order to improve: the process of formation and learning of their students, the generation of new knowledge produced by research and the transference of said knowledge by means of publication and technical assistance. The processes of management of knowledge, organizational learning and information are intimately linked. Therefore, significant improvements can only be obtained in organizations if synergies are generated between each one of these processes. In order to study these three processes, the Universities' Library Systems of the Pontificia Universidad Católica de Valparaíso were selected as a unit of analysis, and considered as places of knowledge gathering, documentation centres and active agents in the development of abilities in the use and transference of information necessary to generate new learning and knowledge. The principal objective of this investigation was to characterize the management of information, knowledge and organizational learning in a university's library system, analysing its relationship and the way that these processes differ depending on variables such as department membership, the characteristics of users that rely on them, etc. The efficient management of organizational learning implies not only the utilization of

Fig. 6.4.2: Short Display of Record details (Browsing)

BURA allows users searching all repositories and is shown through three screen snapshots (Fig. 6.4.3 through Fig. 6.4.5).



Fig. 6.4.3: Searching all Repositories in BURA for Metadata Harvesting



Fig.6.4.4: Display of Search Results (Searching)

The screenshot shows the BURA website interface. At the top, there is a navigation bar with 'HOME', 'ABOUT', 'BROWSE', 'SEARCH', and 'HELP'. The main header includes 'The University of Burdwan' logo and the motto 'Learning Leads To Emancipation'. The page title is 'Search Global Repositories @ BURA'. A breadcrumb trail shows 'Home > Browse > E-LIS repository > Record Details', with 'Record Details' circled in red. On the right, there is a 'USER' login box with fields for 'Username' and 'Password', a 'Remember me' checkbox, and a 'Log In' button. The main content area displays the record details for 'Open Access... from the librarian's point of view' in an E-LIS repository. A table lists the following metadata:

FIELD	VALUE
Title	Open Access... from the librarian's point of view
Creator	Subirats-Coll, Imma Melinščak-Zlodi, Iva Pavelić, Damir
Subject	BA. Use and impact of information. ED. Intellectual property: author's rights, ownership, copyright, copyleft.
Description	1.INTRODUCTION During the last decade of 20th century the dissatisfaction with the current situation in scholarly communication and publication has grown continuously. Although the fast development of information technology has brought the promise of instant and low-barrier access to all kind of information, including scholarly information, the reality was different. The number of online available information has risen, but their prices and subscriptions continued to rise as well. The so-called 'serial crisis' has been discussed in literature and illustrated by large amount of statistical data (e.g. ARL statistics). A number of initiatives striving to ensure "open access" to scholarly information and to bring control over publishing process back to scholars, emerged in late nineties and in the first years of the 21st century (Open Archives Initiative, Scholarly Publishing and Academic Resources Coalition - SPARC, Public Library of Science, Budapest Open access Initiative etc.). By 2004, these initiatives, as well as ideas they represent, became largely recognized and respected by the scientific community, and the term "Open

Fig.6.4.5: Short Display of Record details (Searching)

In the same way users can also restrict search within a repository and is demonstrated through three screen snapshots (Fig. 6.4.6 through Fig. 6.4.8).

The screenshot shows the BURA website search results page. The breadcrumb trail is 'Home > Search'. The search results are displayed in a table with columns for 'All' and 'Archives'. The search term 'open access' is entered in the search box. The results show a list of repositories: 'All Archives', 'E-LIS repository', 'LDL Librarians' Digital Library', 'Cadair 1.8.2', and 'ePrints@IISc'. Below the search results, there is a 'Search tips' section with a list of guidelines:

- Search terms are case-insensitive
- Common words are ignored
- By default only entries containing *all* terms in the query are returned (i.e., *AND* is implied)
- Combine multiple words with *OR* to find articles containing either term; e.g., *education OR research*
- Use parentheses to create more complex queries; e.g., *archive ((journal OR conference) NOT theses)*
- Search for an exact phrase by putting it in quotes; e.g., *"open access publishing"*
- Exclude a word by prefixing it with *-* or *NOT*; e.g., *online -politics* or *online NOT politics*
- Use *** in a term as a wildcard to match any sequence of characters; e.g., *soci* morality* would match documents containing "sociological" or "societal"

At the bottom, there is a 'Language' dropdown menu set to '(None)'.

Fig. 6.4.6: Searching specific Repository (Metadata Harvesting)

Search Results

[REVISE SEARCH](#)

Open Access... from the librarian's point of view
 Subirats-Coll, Imma; Melinščak-Zlodi, Iva; Pavelić, Damir
 2013-05-16
[VIEW RECORD](#) | [VIEW ORIGINAL](#)

How OSI is helping to make open access happen
 Friend, Frederick J.
 2013-05-16
[VIEW RECORD](#) | [VIEW ORIGINAL](#)

The case for open access publishing, with special reference to open access journals and...
 Moller, Allison
 2013-05-16
[VIEW RECORD](#) | [VIEW ORIGINAL](#)

Open Access von A bis Z
 Stieg, Kerstin; Pavlovic, Karlo
 2013-05-16
[VIEW RECORD](#) | [VIEW ORIGINAL](#)

Looking at the forthcoming Berlin 5 Open Access Conference, Padova 19-21 September 2007
 Tallandini, Laura
 2013-05-16
[VIEW RECORD](#) | [VIEW ORIGINAL](#)

Sociological implications of scientific publishing: Open access, science, society,...
 Herb, Ulrich
 2010-02-01
[VIEW RECORD](#) | [VIEW ORIGINAL](#)

Open Access for the Medical Librarian
 Morrison, Heather; Waller, Andrew
 2013-05-16
[VIEW RECORD](#) | [VIEW ORIGINAL](#)

Open Access - Ein Wundermittel? Wissenschaft, Gesellschaft, Demokratie, Digital Divide

Fig. 6.4.7: Display of Search Results from specific Repository (Metadata Harvesting)

Record Details

The case for open access publishing, with special reference to open access journals and their prospects in South Africa

E-LIS repository
[VIEW ARCHIVE INFO](#)

FIELD	VALUE
Title	The case for open access publishing, with special reference to open access journals and their prospects in South Africa
Creator	Moller, Allison
Subject	ED. Intellectual property: author's rights, ownership, copyright, copyleft.
Description	<p>Open access publishing is an initiative that aims to provide universal, unrestricted free access to full-text scholarly materials via the Internet. This presents a radically different approach to the dissemination of research articles that has traditionally been controlled by the publishing enterprise that regulates access by means of subscriptions and licences fees levied on users, predominantly academic libraries.</p> <p>In presenting the case for open access publishing, the thesis explores the contemporary research environment, changing modes of knowledge production, the problems associated with the existing academic journal system, and the subsequent growth of the open access movement as an intervention to reclaim scientific communication. It highlights the ways in which open access better answers the requirements of researchers, funders, governments, and society more broadly. Free access to publicly funded scientific research is more democratic and is necessary for knowledge dissemination and production in a knowledge economy, particularly for developing countries such as South Africa. Attention is drawn to the ways that open access intersects with the ethical norms guiding the practice of research, with the idea of information as a public good, and with other parallel initiatives that resist the enclosure of knowledge through excessive copyright legislation.</p> <p>The study also closely interrogates the economic viability of open access journals, and shows how the 'author pays' model represents a reasonable approach, but by no means the only one available to publishers considering the transition to open access. Sections are also devoted to examining the impact potential of open access articles and the ways in which open access journals can achieve greater permanence.</p>

Fig. 6.4.8: Short Display of Record details from specific Repository (Metadata Harvesting)

6.5 Subject Authority Management

DDC (22nd edition - up to 3rd summary) has been incorporated in BURA software framework to enhance subject categories (as proposed in Chapter 4 and as demonstrated in section 5.4 of chapter 5) that allows users browsing and searching specific subject category. It helps user finding a subject category which may not be organized under Communities and Sub-communities of BURA software framework or has not been categorized in the proposed model.

It (DDC) can be displayed by simply clicking on the link in the left side of the navigation panel and user can navigate throughout the list and can select appropriate subject category(ies) (Fig. 6.5). This window displays the main divisions and sub-divisions of DDC in English.

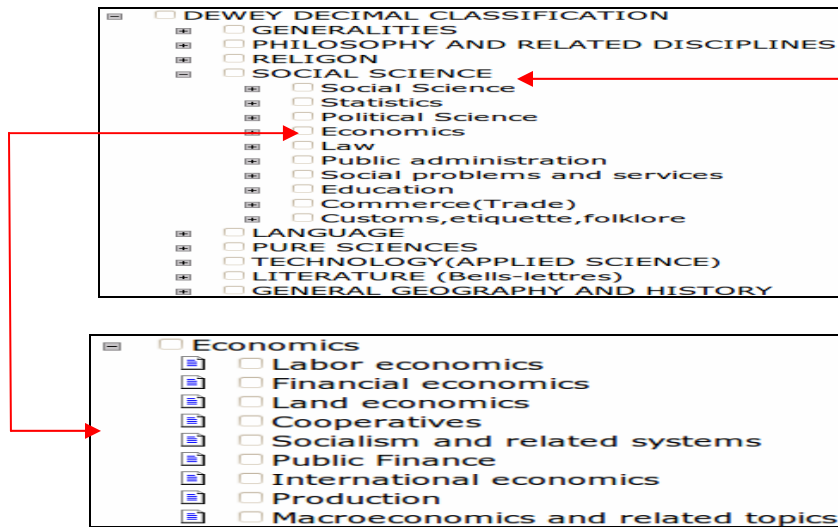
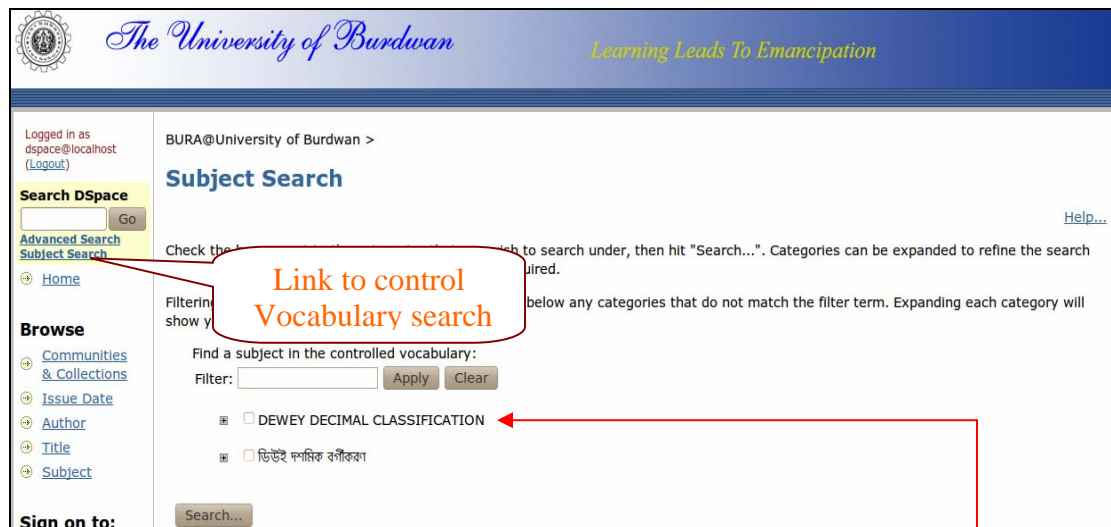


Fig. 6.5: Subject Search Interface in DDC (English)

The subsequent window (Fig. 6.5.1) displays all subject categories of DDC in Bengali. Each broad subject has a hierarchical listing of subject categories/sub-categories and is grouped under those subjects. These keywords are organized in a subject tree (or subject taxonomy) which appears during searching as well as indexing process. Top level terms are displayed and user can navigate any of the top term by simply clicking on it. The plus sign (+) indicates that category has sub-categories and/or links to resources under it.

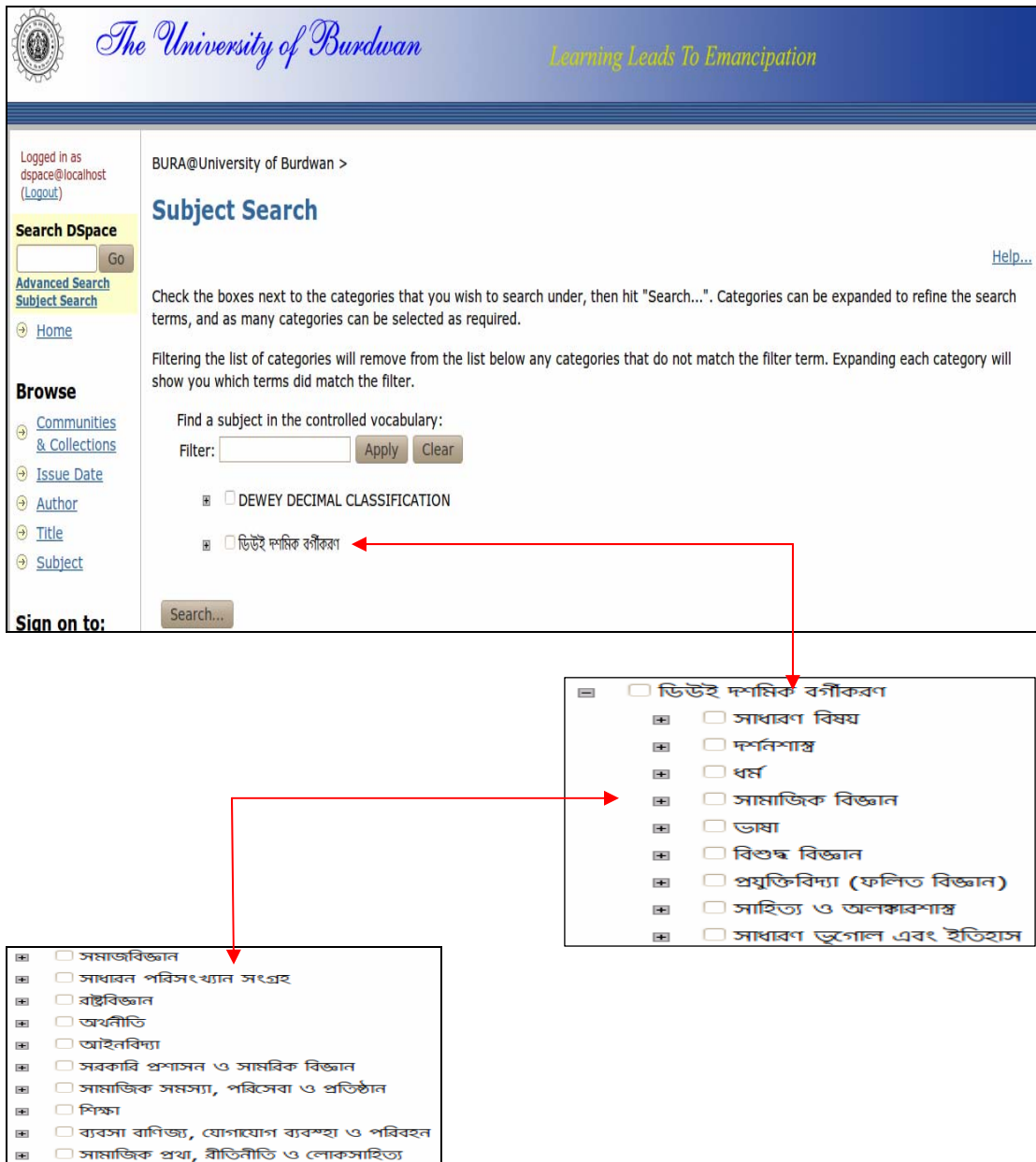


Fig. 6.5.1: Subject Search Interface in DDC (Bengali)

The process of searching of specific subject category in Bengali is shown in two screen snapshots (Fig. 6.5.2 & Fig. 6.2.3). For example, four different subjects (here রাষ্ট্রবিজ্ঞান; অর্থনীতি; সামাজিক সমস্যা, পরিষেবা ও প্রতিষ্ঠান; শিক্ষা) under ‘Social Science’ have been displayed along with its sub-divisions.

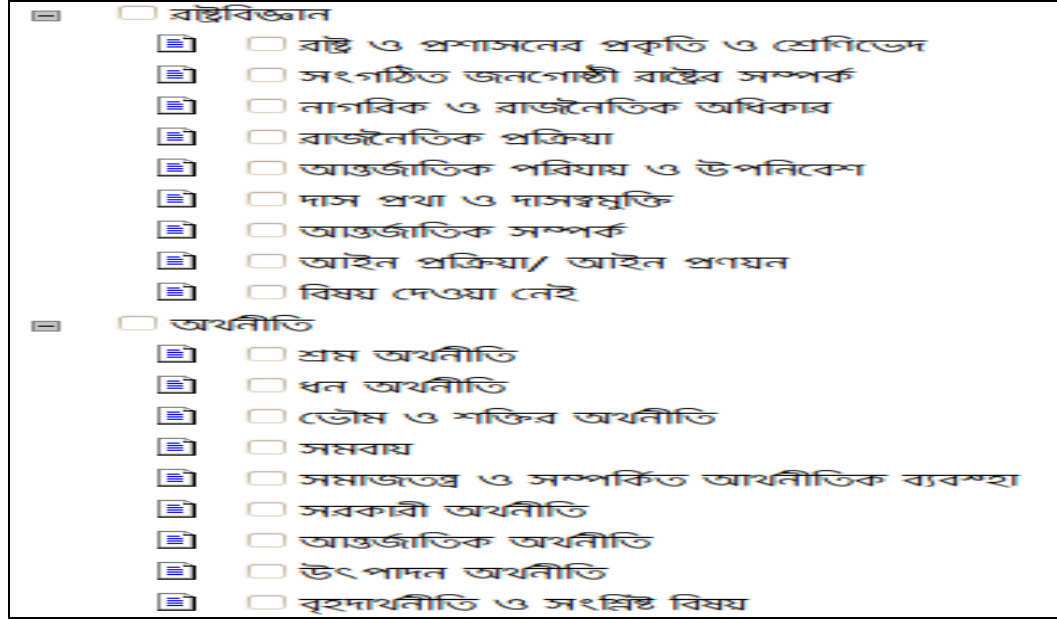


Fig. 6.5.2: Subject Searching in DDC (Example 1)

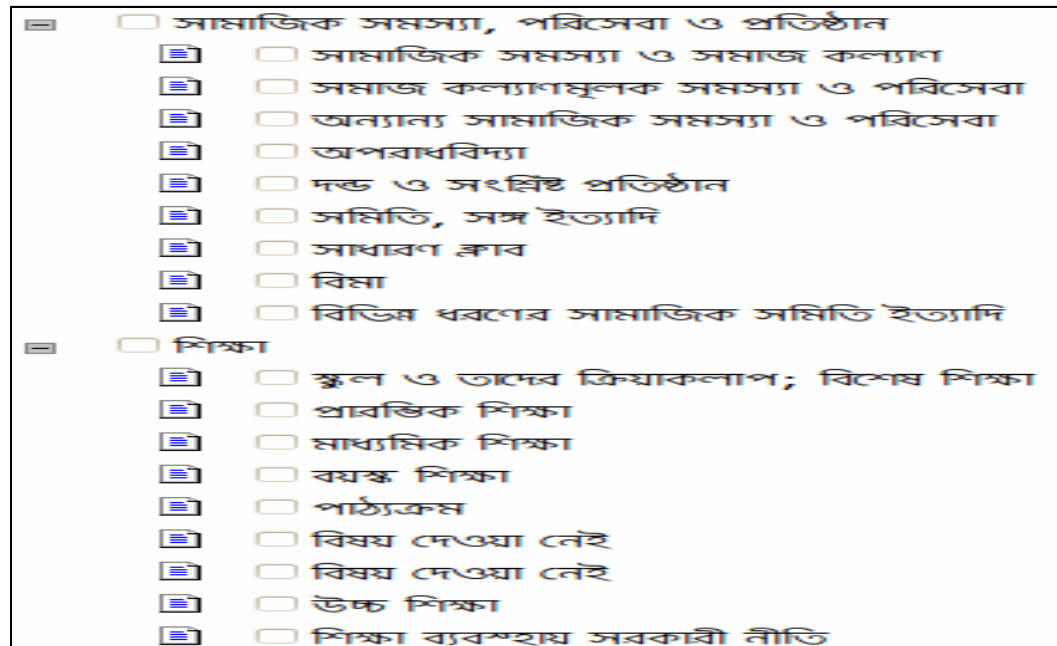


Fig. 6.5.3: Subject Searching in DDC (Example 2)

Another novelty of this research is that this software framework allows users to filter documents against a standard subject division/subdivision (taken from DDC). After putting a term in search box (here জল and আমেরিকা), it displays all the subject categories having matched with the term. It shows all the links/or fields related with that particular term and is shown through different screen snapshots (Fig. 6.5.4. & Fig. 6.5.5).

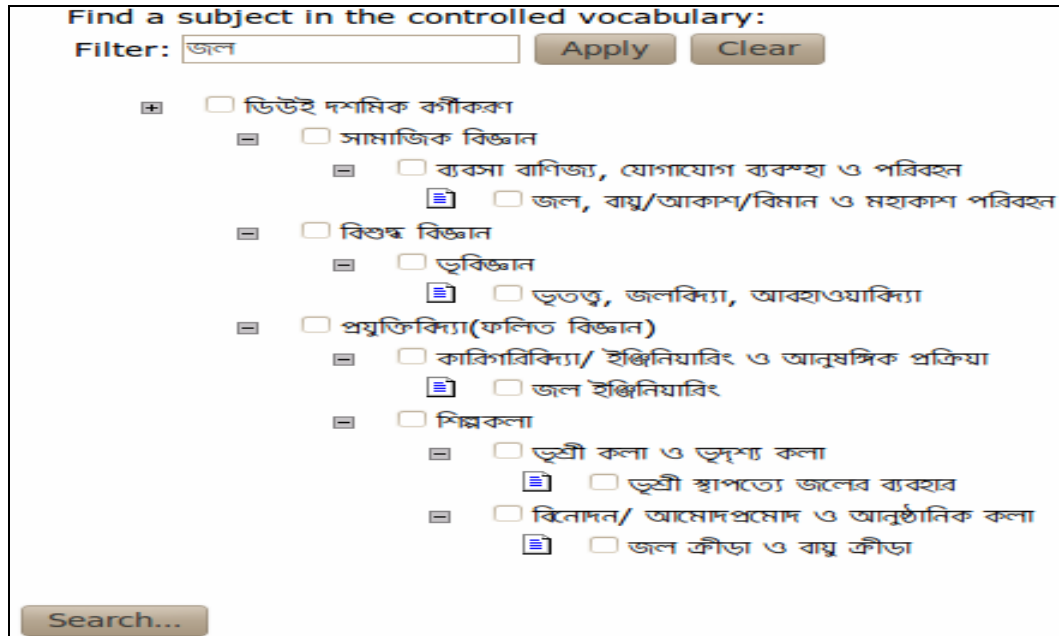


Fig. 6.5.4: Filtering of Subject Searching (Example 1)

Find a subject in the controlled vocabulary:

Filter: আমেরিকা

- ডিউই দশমিক বণীকরণ
 - সাধাৰণ বিষয়
 - সাধাৰণ বিশ্বকোষ
 - আমেরিকান ইংরেজি ভাষাৰ বিশ্বকোষ
 - সাধাৰণ সাময়িকপত্ৰ
 - আমেরিকান ইংরেজিতে সাময়িকপত্ৰ
 - সাধাৰণ প্ৰতিষ্ঠান ও প্ৰদৰ্শকিয়া
 - উত্তৰ আমেরিকাৰ প্ৰতিষ্ঠান
 - সংবাদ মাধ্যম, সংবাদপত্ৰ ও সাংবাদিকতা
 - উত্তৰ আমেরিকাৰ সংবাদপত্ৰ ও সাংবাদিকতা
 - সাধাৰণ ৰচনা সংগ্ৰহ
 - আমেরিকান ভাষায় প্ৰকাশিত ৰচনা সংগ্ৰহ
 - ধৰ্ম
 - খ্ৰীষ্টীয় ইতিহাস ও গিৰ্জাৰ ইতিহাস
 - উত্তৰ আমেরিকাৰ খ্ৰীষ্টীয়ধৰ্মেৰ ইতিহাস
 - দক্ষিণ আমেরিকাৰ খ্ৰীষ্টীয়ধৰ্মেৰ ইতিহাস
 - সামাজিক বিজ্ঞান
 - সাধাৰণ পৰিসংখ্যান সংগ্ৰহ
 - উত্তৰ আমেরিকাৰ পৰিসংখ্যান
 - দক্ষিণ আমেরিকাৰ পৰিসংখ্যান
 - ভাষা
 - অন্যান্য দেশেৰ ভাষাসমূহ
 - উত্তৰ আমেরিকাৰ ভাষা
 - দক্ষিণ আমেরিকাৰ ভাষা
 - বিশুদ্ধ বিজ্ঞান
 - ভূবিজ্ঞান
 - উত্তৰ আমেরিকাৰ ভূবিজ্ঞান
 - দক্ষিণ আমেরিকাৰ ভূবিজ্ঞান
 - সাহিত্য ও অলঙ্কাৰশাস্ত্ৰ
 - ইংরেজি আমেরিকান সাহিত্য
 - অন্যান্য ভাষাৰ সাহিত্য
 - সাধাৰণ ভূগোল এবং ইতিহাস
 - ভূগোল ও ভ্ৰমণ
 - উত্তৰ আমেরিকাৰ ভূগোল ও ভ্ৰমণবৃত্তান্ত
 - দক্ষিণ আমেরিকাৰ ভূগোল ও ভ্ৰমণবৃত্তান্ত
 - উত্তৰ আমেরিকাৰ ইতিহাস
 - মধ্য আমেরিকা; মেক্সিকো
 - আমেরিকা যুক্তৰাষ্ট্ৰ
 - উত্তৰ পূৰ্ব আমেরিকা যুক্তৰাষ্ট্ৰ
 - দক্ষিণ – পূৰ্ব আমেরিকা যুক্তৰাষ্ট্ৰ
 - দক্ষিণ মধ্য আমেরিকা যুক্তৰাষ্ট্ৰ
 - উত্তৰ মধ্য আমেরিকা যুক্তৰাষ্ট্ৰ
 - পশ্চিম আমেরিকা যুক্তৰাষ্ট্ৰ
 - আমেরিকা প্ৰশান্ত মহাসাগৰীয় অঞ্চল

Fig. 6.5.5: Filtering of Subject Searching (Example 2)

The filtering process is also available at the time of indexing. Indexer can put desired term(s) directly in appropriate box at the time of searching as well as may pick up category(ies) from integrated vocabulary control device (here DDC). It should be pointed out that indexer may opt for any number of subject categories or subject divisions for populating subject access field in a given metadata schema (here DC.Subject). The moment indexer clicks against a search query, it will expand the subject categories and the system displays all the sub-divisions of the term matched (Fig. 6.5.6 through Fig. 6.5.9).

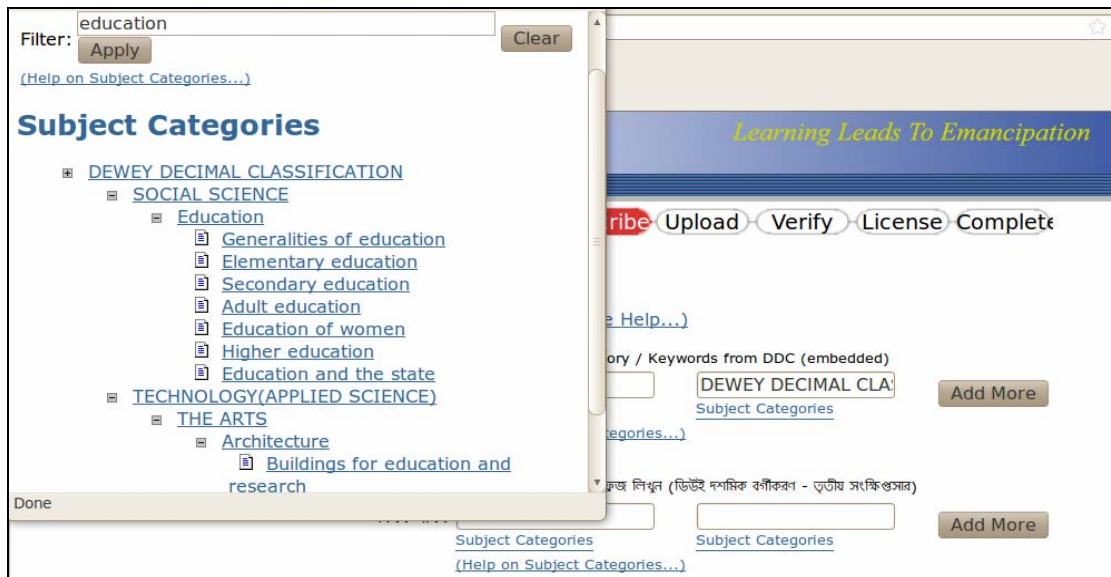


Fig. 6.5.6: Indexing of Subject Term: Category 1 (Example 1)

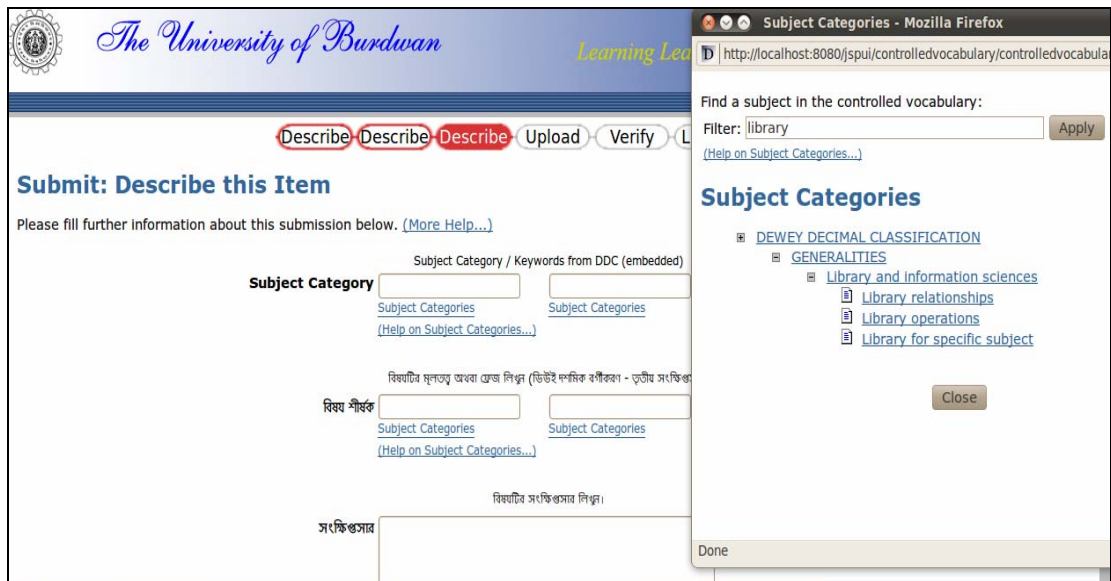


Fig. 6.5.7: Indexing of Subject Term: Category 1 (Example 2)

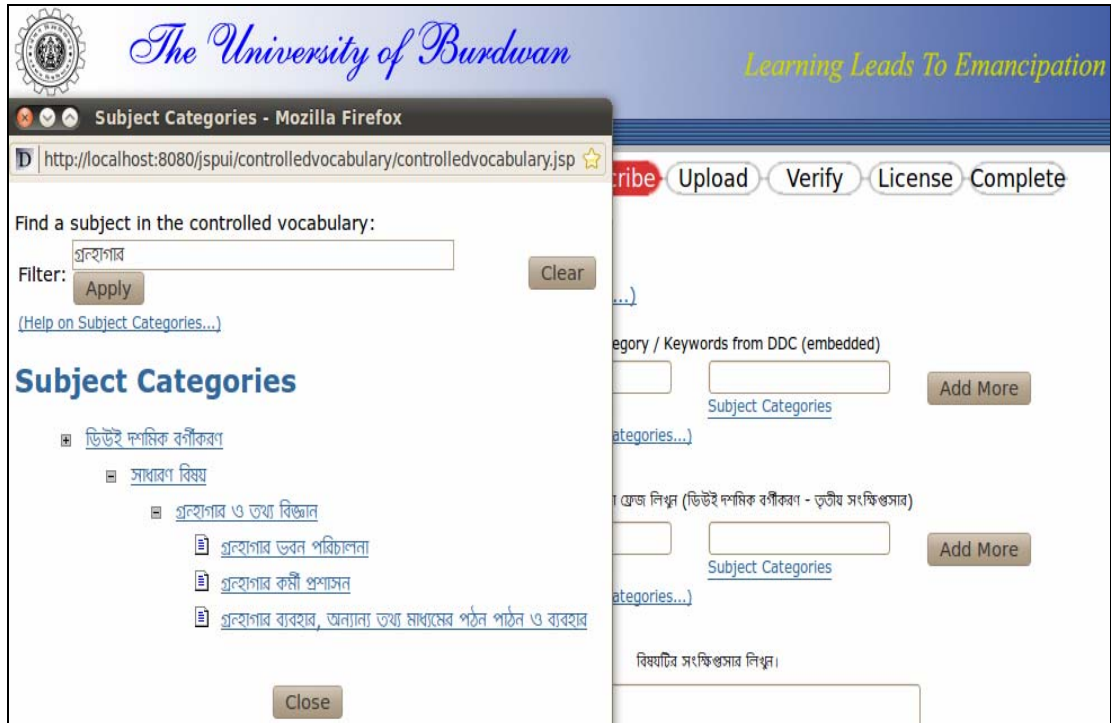


Fig. 6.5.8: Indexing of Subject Term: Category 2 (Example 1)

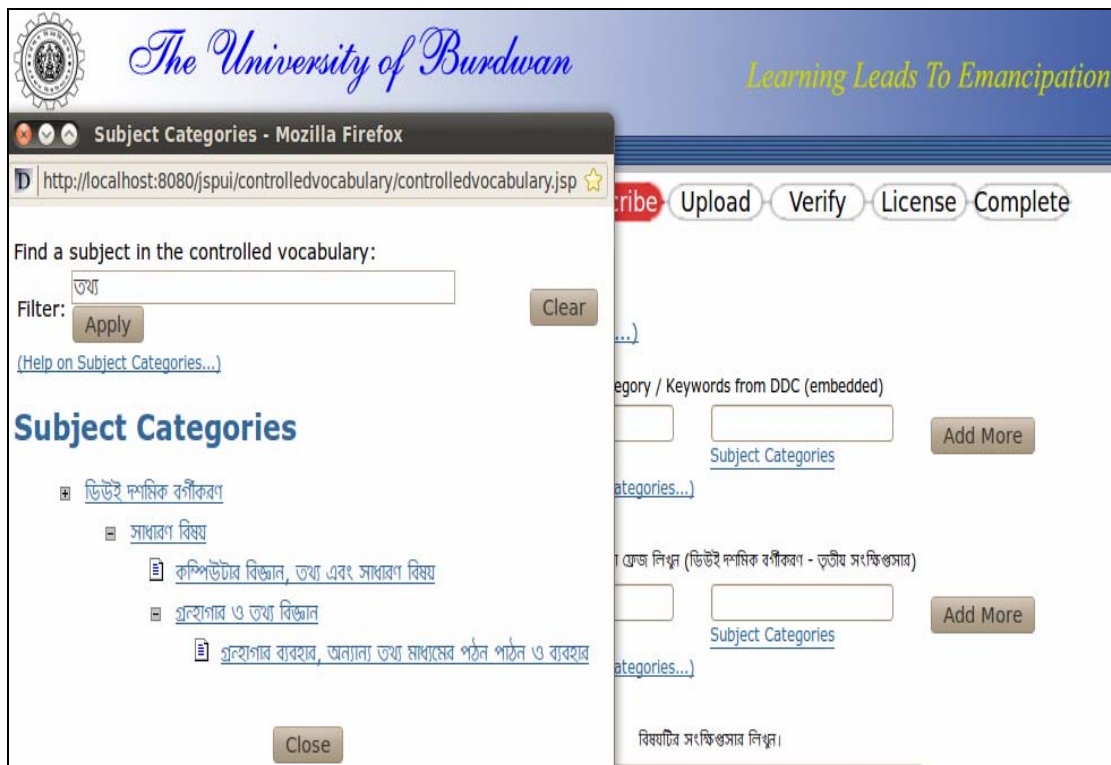


Fig. 6.5.9: Indexing of Subject Term: Category 2 (Example 2)

6.6 Utility Services

BURA User Interface provides access to various Web tools like Blogs, RSS to support real-time interactive communication facilities for BURA members. These software tools are also termed generically as ‘social networking software’.

A RSS

RSS alternatively defined as “Really Simple Syndication” or “Rich Site Summary”. Feeds (e.g. RSS/Atom feeds) are used in customized alert services to send information on new articles of interest in the repository. A Feed is a function of special software that allows Feed readers to access a site automatically looking for new contents and then post updates about that new content to another site. This provides a way for users to keep up with the latest information posted on different blogging sites and other Web services that are compatible to Feed. It keeps track of new items of interest in their favourite feed readers. Like other repositories, BURA has an RSS feed (Fig. 6.2.1) that can be incorporated into readers and other Web applications, boosting accessibility to the works. Access to RSS feed from BURA user interface is shown here through two screen snapshots (Fig. 6.6 & Fig. 6.6.1).

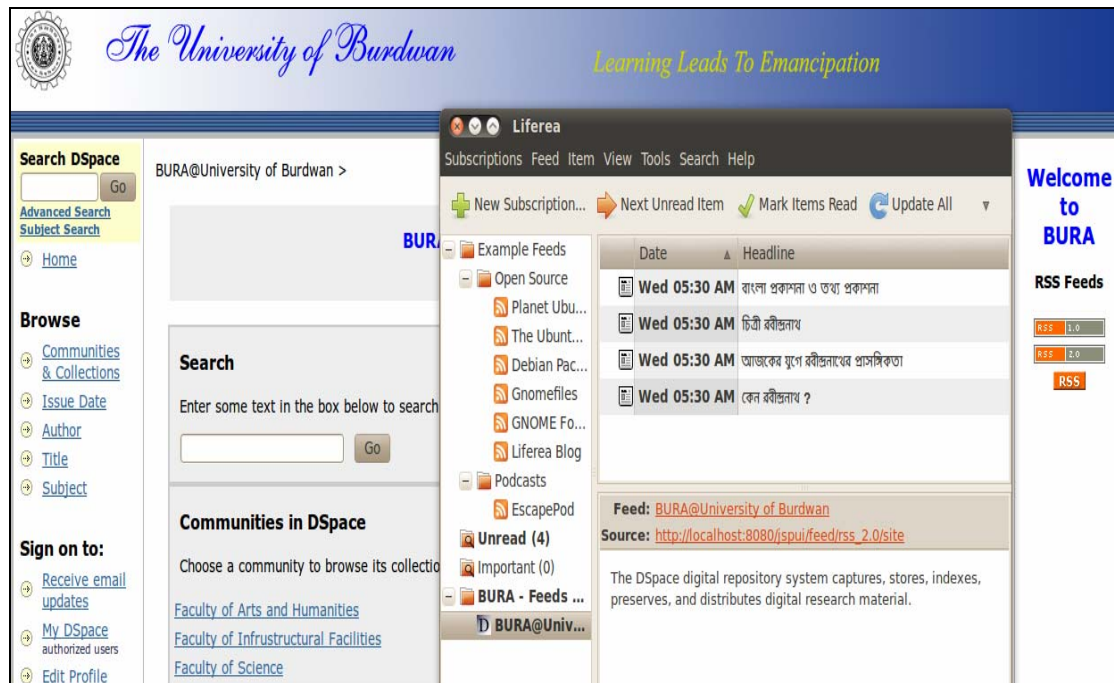


Fig. 6.6: Searching Latest Submission using RSS Feed

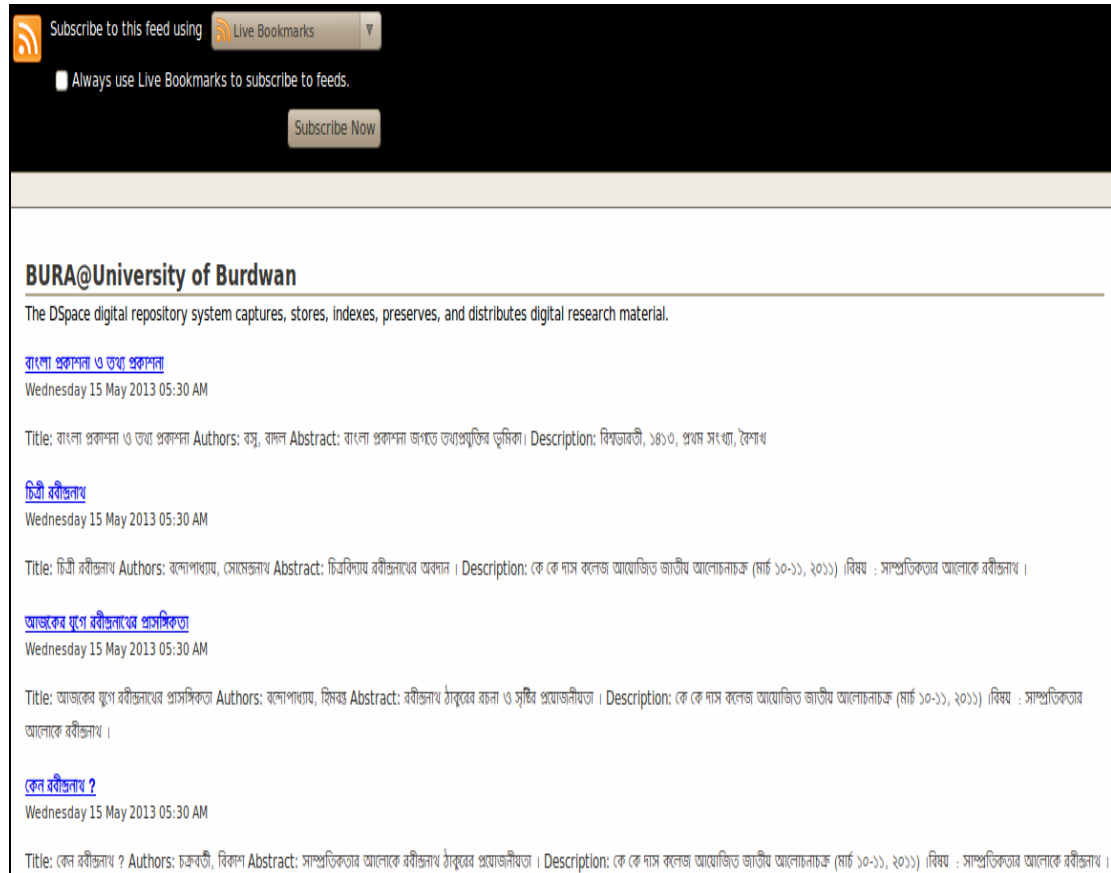


Fig. 6.6.1: Short Display of Search Result using RSS

B Blog

Another community interaction provision in BURA software framework is blogging. Blog is an abbreviated version of weblog. Web logs or Blogs software are now quite popular for two reasons – a Blog software can automatically report inclusion or submission of new information from a group of selected Website and provides opportunities to submit full length articles, news, views etc. on various topic and subjects and access archival information in an interactive ways. The blogging facility in BURA software framework is demonstrated here through three screen snapshots (Fig. 6.6.2 through Fig. 6.6.4). The first link opens registration window (Fig. 6.6.2) for new users and the second link (Fig. 6.6.3) is meant to access blog services for already registered users. Users can pick up any category to display posting of message, comments or full length article under it and to post new message, comment, article or response against any posted material (Fig. 6.6.4).

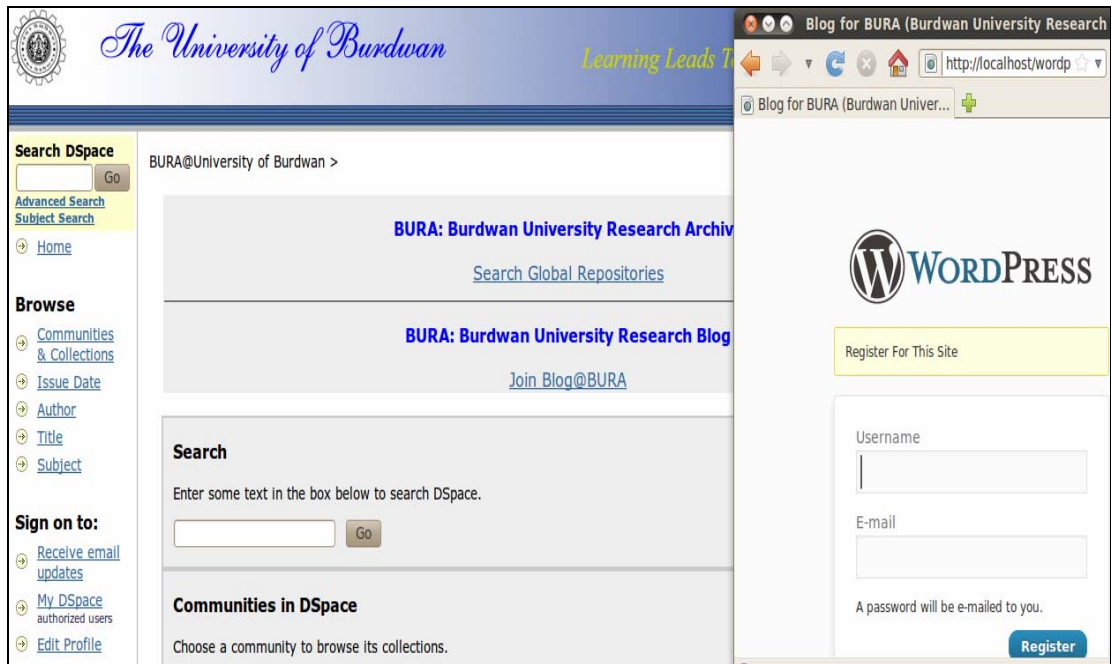


Fig. 6.6.2: New User Registration to Blog of BURA

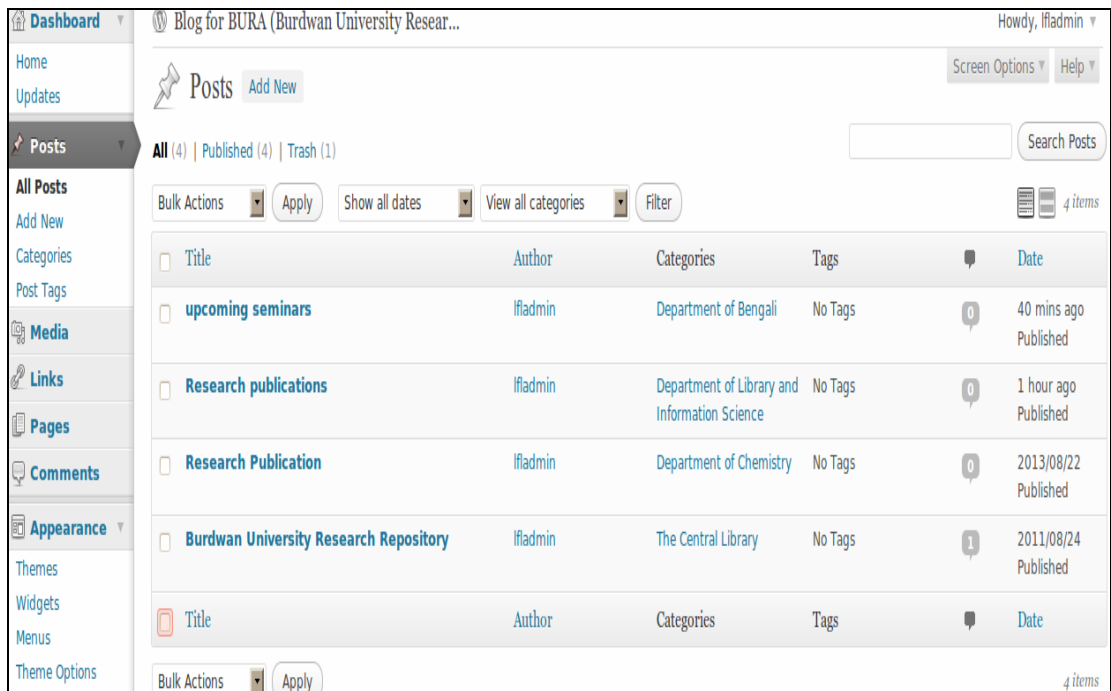


Fig. 6.6.3: Categories of Services of Blog of BURA

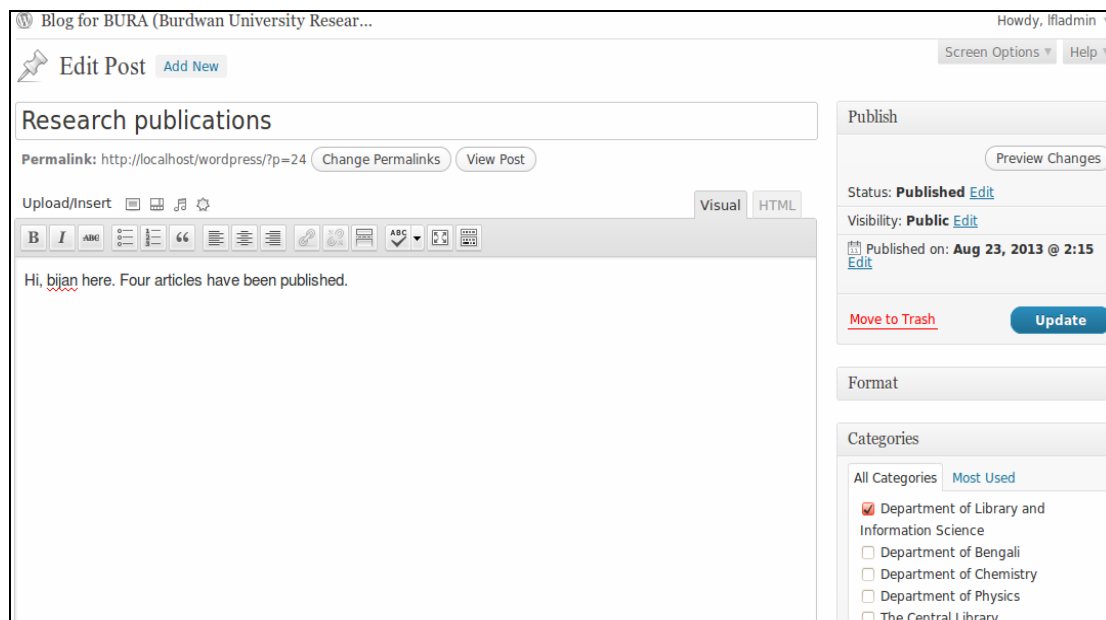


Fig. 6.6.4: Access to Blog Service from BURA User Interface

6.7 Miscellaneous Administrative Services

BURA has been actively involved in the development of add-ons for that platform and offers several other services to the users. These services are equally important from administrator point of view in order to keep the system active and are considered essential for smooth running of BURA. Among these, the most noteworthy are:

A Preservation and Migration Services

Preservation implies some additional specialized work on repository contents. It must provide the expertise for long-term storage and curation of digital data. BURA is committed to preserving the bit stream (the binary form of the data). BURA provides long-term access to submitted works, as well as associated descriptive and administrative metadata, by employing a strategy combining the following:

- Secure backup
- Storage media refreshment
- File format migration (including possible migration to preferred formats during submission)

B Embargo Management

Embargo Management is an important part of access control policy and BURA morally supports access restriction of contents by imposing embargo period (as

prescribed in section 4.2.1.6 of chapter 4) on it. In some cases, users may want to keep their contents limited-access for a set time period, so that they can get a patent, obey a publishing contract, or prepare for a coordinated announcement. It's much easier if depositors can just say "keep this limited access until this date, and then open it up," and the repository service handles matters from there.

C Access Control and Rights Management

The system (BURA) should support for users and groups, authentication and authorization methods and must impose level of restriction for access and update collections, digital objects and contents. BURA allows three types of resource access: full text access, privileged access, and restricted access (as proposed in section 4.2.1.6 of chapter 4). Access control policies can be enabled by the repository authorization module that allows access at the item level and at the bit stream level. Upon successful authentication, BURA users can be automatically classified into a default group specified in the DSpace configuration file (i.e. `dspace.cfg`). This allows a BURA administrator to grant relevant group privileges to be inherited by group roles.

D Removal of resources

BURA allows and reserves the right to remove a work submitted to a Collection on special circumstances (vide section 4.2.1.16 & 4.2.1.16.1 of chapter 4). This consists of two parts:

- *Withdraw*
 - Removes item from view
 - Does not show up in search results
 - Recoverable

- *Permanently delete*
 - Unrecoverable
 - Handle is not reused
 - Can only be done by a repository administrator

E Usage data

The purpose of the statistics add-on is to promote BURA and author self- or mediated-archiving, by demonstrating the worldwide accessibility and usage (access/downloads) of archived documents. BURA generates various access and downloading reports and offers system statistics for administrator usage, as well as usage statistics on the level of items, communities and collections. This service provides feedback on repository usage (e.g. downloads, citations, etc.). It facilitates statistical analysis from the database.

Chapter 7

Conclusion



“Now this is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning”.

Winston Churchill (Speech
at the Lord Mayor's Luncheon, Mansion House, London, 10 November, 1942)

Structure

- 7.0 Introduction
- 7.1 Novelties of the Study
- 7.2 Limitations of the Study
- 7.3 Scope of Further Research

7.0 Introduction

Research is thus characterised by the fact you can not know in advance exactly where you are heading when you begin the long walks into the new territory to be explored. Hence, at the beginning of this study six years ago, this mastodon-sized dissertation with around four hundred pages of text. The overall objectives of this study have been to yield a conceptual model for University-specific IDR and to develop open source software based framework for actualization of the model. The previous three chapters of this study namely chapter 4, 5, and 6 shows the achievements in general as well as specific objectives as framed in chapter 1. Chapter 4 presents the development of model and actualization of its technical components through Unicode-compatible FLOSS (Free/Libre Open source Software) based software framework. Chapter 5 deals with the development and practical implementation of the model through application of open source software and open standards. This framework shows the customization of user interface and concerns with the integration of harvesting software along with ontology driven vocabulary control device as well as user interaction communication tools. Chapter 6 shows the features and facilities of the software framework and its application in organization of IDR resources and managing Indic script based resources in a Unicode-compliant multilingual environment. The chapter also demonstrates Bengali script based user interface to search and browse IDR resources along side real-time integration of Bengali script based DDC based vocabulary control. This study thus may contribute to Library and Information Science including Web-enabled digital repository services by providing elements of a novel conceptual framework along with an off-the-shelf digital solution. In the final note, we may conclude that this research work kept its promises to develop an IDR model suitable for the University of Burdwan keeping in mind the requirements of the scholars and academia. The model conforms to the global recommendations for the IDR domain and thereby overcomes present constraints in developing IDR system in a developing country like ours. However, we may conclude this study under the following heads:

7.1 Novelties of the Study

7.2 Limitations of the Study

7.3 Scope of Further Research

7.1 Novelties of the Study

This doctoral dissertation may contribute to Library and Information Science in general and university specific Web-enabled distributed IDR system in particular through achieving following attributes that are useful in dissemination of university specific Web-enabled IDR services:

A.1 Unicode-compliant Bengali script based user interface along with provision of storing, processing, organising, retrieval and export/import (standards based) of multi-script records.

Local language or script based user interface is not the only requirement for a multilingual information retrieval system but such a system needs to support storing, processing, retrieval and exchange (export/import) of multi-script records. BURA software framework supports all these features including standards (METS/MODS etc.) based export/import of Unicode-compliant Bengali script based resources. Any IDR system thereby can utilize this software framework to support Bengali script based information retrieval and other associated services and the mechanism may be applied to manage other Indic scripts based resources.

A.2 A single window interface to access an array of Library 2.0 tools

BURA software framework has provision to integrate with other emerging technologies and integrates a number of social networking tools that provides services based on a set of web 2.0 tools like RSS, Blog, e-mail subscription and notification etc. The system has provision of incorporating such social networking tools in order to provide better services to its members. All these facilities in the software framework are provided through Unicode-compliant Bengali script based interface.

A.3 Secured user-driven access and submission of items or records

This system, as it is based on distributed architecture, allows remote access and submission by users (registered) or community members (BURA) from any place. This software framework has provision to support remote access and submission of records over the web against proper authorization and authentication (on the basis of LDAP – Light Directory Access Protocol standard).

A.4 Integrated single window Bengali script based interface that supports simple and advanced search in multilingual environment along with listing of recent additions and deletion of records

The system has provision to develop mechanisms for processing, retrieval and display of Indic script based information objects making software framework Unicode-compliant entity and has provision to design and apply multilingual user interfaces at different levels and different points of utilization.

A.5 Standardized data entry format for IDR resources integrated with data standardization tools including vocabulary control device

The system supports and is based on structured and internationally agreed upon standards for long-term storage, file format, export and import of files etc. The software framework provides a data entry framework on the basis of Dublin Core/Qualified Dublin Core metadata standard to identify items. It manages resource description for learning objects and ETD through domain-specific metadata schemas (IEEE-LOM for learning objects and ETD-MS for ETDs). Dublin core (DC), as a common minimum elements set is useful not only for indexing, but also for listing and browsing results. Unqualified Dublin Core has been the basic metadata format, useful for interoperability. Dublin Core registry can be extended. The system uses and supports integration of data standardization tools like controlled vocabulary device, code list etc. for standardization of data entry activities to facilitate subject access by organizing IDR resources.

A.6 Provision of community interaction tools

The system has provision to integrate Web 2.0 tools i.e. Blogs and RSS. User interface provides links to access these tools through easy-to-use Bengali language based interface. The Bengali language based user interface for Blog (Wordpress) is used as FLOSS based software to support blog facilities in BURA.

A.7 Integrated backup utility

The software framework uses DSpace in the IDR Cluster (Cluster-II) to manage IDR resources and bibliographic items. DSpace uses PostgreSQL as backend RDBMS to store Dublin Core formatted records. This software framework applies pgAdmin III as an integral tool for maintenance, backup and restoration.

A.8 Display of usage statistics

Usage and download statistics are becoming increasingly important as access and dissemination are key priorities for a repository. Usage statistics are a means of expressing and understanding the impact and usage of the resources contained within the system. Download statistics and other usage tools are more accessible to implement and use in the BURA software framework.

A.9 Customized Workflows

The software framework offers several types of workflow - workflows to manage user registration and administration; workflows to manage authorization and permissions; and various administrative workflows to allow easy maintenance and software updates. However, the most significant achievement is the workflow that focuses on the submissions process. It ensures separate submission interfaces for different object types to display relevant metadata schema. The system has provision to remove unwanted submissions.

A.10 Open Standards Based

The software framework is based on global standards in relation to metadata, interoperability, network, export/import etc. These standards ensure that data remains free, migration to competing platforms is possible and interoperability with other open standards based systems is guaranteed. Standards are stable and highly recognized, which makes IDRs interoperable and the creation of a world-wide digital library nearer.

A.11 Multilingual and regional language based submission interface

The system has provision to make the software framework Unicode-compliant through the application of an array of FLOSS based multilingual tools for storing, processing and retrieving of objects available in Indic scripts. The system support multilingual search (simple and advance), retrieval, and export/import of IDR resources. In addition to these end-user level facilities this software framework supports – i) Bengali script based registration interface; ii) Bengali script based submission interface; and iii) Bengali script based administrative interface.

A.12 Federated single window embedded search interface for multiple OAI-PMH compliant IDRs

This research work recommended provision for federated search mechanism and integration of federated search option to retrieve resources

from multiple IDRs system. This research work has fulfilled that promise by developing a metadata harvesting framework using PKP harvester that allows users browsing and searching multiple repositories through a single-window search interface.

A.13 Integrated Blog

BURA software framework has provision to integrate with other emerging communication support systems like Blog, Wiki, Discussion Forum etc. It provides a platform to its members where they can make comment, post articles, exchange their views etc. It (Blog) has been incorporated both in administrative interface as well as in user interface of the BURA software framework. All these facilities in the BURA software framework are provided through Unicode-compliant Bengali script based interface.

A.14 Auto alerting services

BURA is fully compliant with RSS feed as RSS 2.0 standard has been incorporated in the BURA software framework. This provides a way for users to keep up with the latest information posted on different blogging sites and other Web services that are compatible to Feed. It alerts users about new addition and displays latest submissions to the repository.

A.15 Subject categorization through DDC (22nd edition up to the 3rd summary)

Provision for incorporation of standard subject category system into any IDR system is vital to satisfy subject approach. This research study has incorporated DDC (22nd edition up to the 3rd summary) following the SKOS standard and XML based format into BURA software framework to enhance subject categories based organization of resources. English language subject divisions and subdivisions are based on DDC 22nd edition and are available at the time of indexing as well as searching. Developing Indic script based subject access system and seamless integration with IDR framework is necessary to meet the subject requirements of the local scholars. This research work has modified DDC (22nd edition up to the 3rd summary) in Bengali script and divisions and sub-divisions of subject categories in Bengali are available during submission and searching.

A.16 Porting of software framework as ISO image

All the modifications, additions and customizations made by this research work is finally available as an off-the-shelf information product which can readily be utilized by libraries of different universities and other knowledge organizations to establish institute-specific IDRs.

7.2 Limitations of the Study

Every research aims to solve a set of interrelated, interlinked and integrated research problems and invariably lands up with a new set of problems, which warrants attention of further research. This study is no exception and there is still a lot of ground to cover in the future. However, studies to date have tended to focus either on technology - how to build up an IDR or on the self-belief – in theory how useful people think their IDR is. Only a few studies are engaged in creating IR policies and procedures for contents management and concerned with technical as well as organizational and legal aspects that should be considered when setting up and running IDR system. The IDR has been developed all around the world during the last decade. But people argue about the success of IDR. Some think IDR has achieved more than they need and some believe it has not met the desired service level. This review looked at what studies have been done, what can be learned from the studies and what the gaps are, and more importantly attempted to develop a software framework keeping in view the required parameters.

This study has been dealt with a wide array of problems during development of the software framework. All these problems may broadly be classified into two groups – problems related with the organization and management of resources along with development of university specific IDR policy and problems originated from Bengali script based computing. Some of the problems are solved satisfactorily during investigation and some problems remained unsolved as these are beyond the control of this study. These unsolved problems may be reported here as limitations of the study. This study attempts to find out possible reasons(s) and tentative solution(s) for these limitations.

Limitation 1

- | | |
|---------------------|--|
| Problem: | Exact rendering and display of some Bengali letter is not possible in BURA software framework. |
| Possible reason: | A few characters of Bengali script are not yet compatible with UTF-8 based rendering as far as existing glyph management systems are concerned. |
| Tentative solution: | The next generation of glyph management systems, based on the latest Unicode standard may solve it as this problem is reported by many researchers in Unicode forum. |

Limitation 2

Problem: Provision of accessing and incorporating learning objects, theses in BURA is quite straight forward and lacks structured approach.

Possible reason: The present rich set of metadata schema for learning objects like IEEE-LOM (with SCORM) is too complex to incorporate in DSpace in its present form.

Tentative solution: The next release of DSpace may include a better metadata management framework to accommodate wide variety of metadata schemas including IEEE-LOM and SCORM.

Limitation 3

Problem: Non-availability of standard category list and vocabulary control devices in Bengali language. These standards are available only in English language. This is a barrier to standardization of subject access terms.

Possible reason: Production of classification system in Bengali or other Indic scripts have limited scopes for commercial viability. Moreover keeping pace with the latest editions demands frequent updating and releases of such products in regional languages.

Tentative solution: Library associations and LIS schools in India may take up this very important task voluntarily; for example this research project applied one such Bengali translation of DDC published by Bengal Library Association but modified extensively to match it with DDC 22nd edition as the translation is based on DDC 20th edition.

Limitation 4

Problem: No display standard for IDR resources and therefore, the search interface of BURA software framework display resources/records in a simple non-standard format.

Possible reason: There is no ISBD like display format standard (like bibliographic data in library catalogue) available for displaying metadata of retrieved knowledge objects.

Tentative solution: BURA software framework displays metadata for retrieved records in simple tabular format due to lack of display standard as mentioned in earlier point.

Limitation 5

Problem: No rules pertaining to the encoding and recording of IDR resources exist and therefore, this study finds problems in organising and managing IDR resources.

Possible reason: Similarly there is no ISBD like encoding/rendering standard (like encoding of bibliographic data in library catalogue) available for organization of metadata elements in domain-specific metadata schemas.

Tentative solution: BURA software framework follows encoding and rendering rules as prescribed in Qualified Dublin Core metadata schema for all domain-specific metadata schemas applied in the software framework for organizing special materials like learning objects, ETDs etc.

Limitation 6

Problem: No internationally agreed standards for long-term storage, export and import of files and metadata in approved formats to new platforms.

Possible reason: This problem is universal in nature for almost all institutional repositories all over the world. It is originated because of the high rate of obsolescence in storage formats and related technologies.

Tentative solution: BURA software framework follows TIFF as mother format and pdf as retrieval document format for most of the resources as these are open standards.

Limitation 7

Problem: No standard mechanism for access control and rights management of the objects deposited to IDR.

Possible reason: Open access philosophy advocates free access to all resources but sometimes local authority needs to exercise some control over some types of documents e.g. access to full-text resources

after six months from the date of award. But till date there is no agreed upon solution for fixing of duration of embargo for different object types.

Tentative solution: Under such circumstances, to keep a balance between open access and needs for local control, BURA software framework sets a default six-month embargo for full-text theses access.

Limitation 8

Problem: No standardized file naming (name resolution) or persistent identification system (inside the framework) is properly followed for identification of objects.

Possible reason: Till date there is no international standard that prescribes naming convention for locally uploaded files; the name of the file is determined by local submitter and there is no control in file naming by the system administrator.

Tentative solution: Under such circumstances, the software framework designed and applied a local naming convention in the following form – two letters for department – two letters for collection type – three letters from surname of the first author/person responsible.

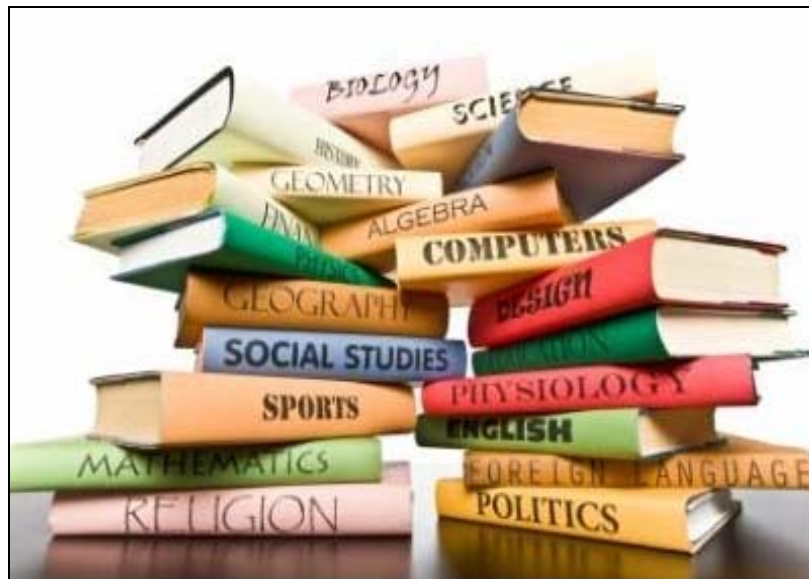
7.3 Scope of Further Research

Research is just like a relay race. It follows a continuous improvement cycle. All systems grow and change depending on the needs of their users. Some of these changes are incremental, such as small modifications to enhance the way the system interacts, while some developments can be more revolutionary, reacting to changes in the environment or organization. IDR is an emerging area of research with enormous possibilities to restructuring its services to the knowledge society. This is the responsibility of this study to earmark the possible areas of further research in the domain of IDR. This chapter considers the potential areas for developments, both large and small, in the domain of IDR. It is, of course, difficult to predict the remote future, so this chapter focuses on the near future. In fact, the scope of further research lies in the limitations of the present study, as mentioned in earlier paragraphs. Unfortunately most of these limitations warrant attention of the standardization bodies, institutions, and library associations working at national and international levels. One limitation of this study is associated with the provision of plain and simple access to learning objects in BURA software framework. Therefore, this area

i.e. integration of open learning standards like SCORM in IDR as an integral part requires urgent attention of further research. In this context provision of organizing resources and its integration with this software framework i.e. BURA may be taken as a research area to increase the scope and utility of BURA. Many researchers, professional organizations, which deal with IDR, are of the opinion that learning support system should be an integral part of such system. In other words, provision of a structured learning system and its integration with the BURA software framework may be taken as a research area to increase the scope and utility of BURA. Most of the IDR system is built on open source software e.g. DSpace, EPrints, Fedora etc. and are freely available in open source domain. These FLOSS based IDR system are fully based on and compatible with LAMP architecture in general and therefore can easily be integrated with the learning contents management software available in public domain.

Finally this study is meant to promote open access to knowledge through establishment of IDR in Indian universities. The directive authorities are also supporting University-specific IDRs. In this context this research work attempts to develop a standard IDR system by using traditional knowledge organization tools, open source software and open standards. It also achieved success in managing storing, processing and retrieving Bengali script based resources including integration of Bengali script based subject access system. The mechanism developed and applied by this research work may be extended to handle other Indian regional languages to satisfy the information needs of a wider section of the society. There are many exciting possibilities for repositories and the resources they hold. And this study is considered and can be used constructively for development efforts. In this context this research study may be viewed as an action in hope rather than hoping for action.

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Book had instant reply long before televised sports.

Bern Willims

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